06:19:06 measuring with traditional is more of
06:19:09 a balancing act?
06:19:11 A. Fundamentally.
06:19:14 Q. And so, for example, is it
06:19:16 possible for a map drawer to create as
06:19:19 part of this balancing act one or two
06:19:22 more county splits or subdivision
06:19:24 splits to comply better with a
06:19:27 different redistricting criteria?
06:19:32 A. Certainly and you heard this by
06:19:34 several.
06:19:35 Q. Right. And so is it fair to
06:19:39 say a plan may still be excellent
06:19:39 overall even if it's not excellent as
06:19:42 to any one redistricting criteria?
06:19:49 A. Yes, it will depend on how
06:19:53 UCONN instruct and there are judgment
06:20:01 calls to make I think that is what you
06:20:03 mean.
06:20:03 Q. Sure. And an excellent so
06:20:08 plans --- or several --- so plans may
06:20:09 be excellent but balance the
06:20:11 traditional criterion different ways?
06:20:16 A. They will have to balance the
06:20:17 traditional criterion different ways.

06:20:17 Q. And so to this point in your
06:20:19 report, you state that we are not
06:20:21 required to choose by a beauty
06:20:22 contest, for example? Beauty comes
06:20:22 with a numerical optimization which
06:20:27 plan's best.
06:20:27 A. Yes and I actually think we
06:20:29 heard the beauty contest quote, which
06:20:32 I think goes back to Sean Marino if I
06:20:36 remember right, cited earlier today
06:20:37 --- and I think that's right. It's
06:20:38 not simply a matter of focusing on one
06:20:41 number and trying to make that very
06:20:43 best number we can make it. We are
06:20:45 doing this view in many factors, some
06:20:51 holistic.
06:20:51 Q. And you've heard the statement
06:20:52 in your second report that rather than
06:20:54 this beauty contest measure, a plan
06:20:56 should be judged in addition to it's
06:21:00 compliance with traditional
06:21:00 restructuring criteria whether the
06:21:02 ultimate affect of the plan would
06:21:03 treat political parties fairly and
06:21:08 even handedly?

06:21:08 A. Yes I would say that is
06:21:09 expressly a goal at issue here.
06:21:11 Q. And you identify the Carter
06:21:12 plan as one of the very few plans
06:21:13 dominating the field of partisan
06:21:16 fairness.
06:21:16 Correct?
06:21:17 A. Let me try to say this
06:21:18 precisely because I actually don't
06:21:20 think I worded this perfectly in ---
06:21:27 in the report. So the Poreto Frontier
06:21:27 consists of plans that are in a kind
06:21:27 of trade-off zone against each other.
06:21:29 And Carter is one of those, which
06:21:32 means that it is not dominated by any
06:21:35 plan. That's a little bit different
06:21:38 than saying it dominates all the
06:21:40 others.
06:21:41 In fact, the Governor's plan is
06:21:42 the one that dominates all others that
06:21:44 are not on the frontier. But the
06:21:46 Carters plan is very strong. I want
06:21:49 to be clear. The Carters plan is very
06:21:53 strong when it comes to the partisan
06:21:54 fairness criteria.

06:21:54 Q. Okay.

06:21:54 So am I --- is it --- is it right to say that the Carter plan being very strong in this measure is one of the very few that maybe doesn't dominates that particular --- but I mean, does it dominates (sic) the criterion of partisan fairness?

06:22:05 A. It means it was dominated by any other plan.

06:22:07 Q. Fair enough.

06:22:08 A. I just wanted to say this right.

06:22:09 Q. Fair enough.

06:22:10 A. And if I remember right that is because it has especially excellent efficiency gap. So one of the scores is the best one.

06:22:11 Q. And further to this point, you explain in your second report that the Carter petitioner's expert Doctor Rodden was one of only three responsible monitors of Pennsylvania's voting day?

06:22:12 A. To be clear what I said was

06:22:35 that there are a few approaches that I
06:22:37 would characterize as responsible
06:22:40 modeling. And I did identify that
06:22:42 approach as responsible. I would not
06:22:44 take that to say I reviewed all the
methods of all the experts and found
everyone else to be irresponsible.
Q. Sure.
A. I just want to be clear.
Q. But Doctor Rodden's method was
responsible?
06:22:55 A. Yes. And what I was referring
06:22:55 to there, that I appreciated in his
06:23:04 report is that he was the --- the only
06:23:04 one that I remember seeing who took an
06:23:05 index and compared it to the local
06:23:05 races. And I think that's just a very
06:23:08 valuable thing to do if we're going to
06:23:09 use statewide elections as we all do
06:23:12 to think about how they comport with
06:23:14 local races that we're modelling.
06:23:14 That's something that I've also done
06:23:20 in previous work.
06:23:20 Q. So one of the criterion you
06:23:23 analyzed in your report was

06:23:23 compactness.
06:23:23 Correct?
06:23:24 A. Yes.
06:23:24 Q. And I believe you testified
06:23:25 earlier that the Carter plan is
06:23:27 recently compact?
06:23:32 A. We could pull up the numbers.
06:23:33 I don't quite remember the number. I
06:23:35 think --- should we do that? Should
06:23:36 we pull up the numbers?
06:23:37 Q. We can but you testified
06:23:39 earlier that all the --- all the plans
06:23:39 that you had reviewed are reasonably
06:23:42 compact with --- fall within a ---?
06:23:43 A. A few of them are markedly less
06:23:45 compact than the others, but by memory
06:23:47 I think Carter was --- has a
06:23:55 Polsby-Popper score of 32 or 33. But
06:23:57 we --- you know, we could pull them up
06:23:58 if we wanted to actually ---.
06:23:58 Q. Sure. But in your report, youi
06:24:01 didn't conclude that the --- the
06:24:01 Carter was not compact?
06:24:02 A. It's --- it's less compact.
06:24:04 Q. But to be clear you didn't make

06:24:06 a finding that it was not --- like ti
06:24:09 didn't comply with the criterion of
06:24:09 compactness?
06:24:10 A. That is right. There is no
06:24:13 bright line that it's on the wrong
06:24:14 side of.
06:24:14 Q. Sure. And you also analyzed
06:24:16 had proposed plans for the respect of
06:24:19 political subdivisions.
06:24:19 Correct?
06:24:21 A. I did.
06:24:25 Q. And as part of that you stated
06:24:26 that the Carter plan is possibly not
06:24:28 excellent when it comes to subdivision
06:24:30 splits?
06:24:31 A. To --- to really back that up,
06:24:32 I would may need to see the table I'm
06:24:35 afraid. But I believe you.
06:24:36 Q. Can --- I think we can pull
06:24:38 that up it is on page two of your
06:24:40 second report. I think there's ---
06:24:47 the text --- the text below is where
06:24:50 the possibly not excellent --- you
06:24:52 know.
06:24:52 A. Okay.

06:24:52 So when it comes to splits, I
06:25:00 judge all the plans to be excellent.
06:25:00 Yes, I see. Yeah, I think that's on
06:25:02 the basis of these split county
06:25:03 subdivisions where it has the most
06:25:06 splits 20 and the most pieces 41. So
06:25:10 if you are going to draw a line among
06:25:12 these plans that on the table it's the
06:25:15 least respectful of that particular
06:25:18 criteria while being very strong at
06:25:20 other things.
06:25:21 Q. Right.
06:25:21 So just like compactness, there
06:25:23 was no finding that the Carter plan
06:25:25 did not comply with the criterion of
06:25:28 respect for subdivision splits?
06:25:30 A. There is no bright line there
06:25:33 either.
06:25:33 Q. Sure.
06:25:41 Q. And as part of your report, you
06:25:42 --- you didn't analyze whether any of
06:25:44 splits in Doctor Rodden's map were the
06:25:44 result of his balancing other
06:25:53 redistricting criteria?
06:25:54 A. I didn't analyze that and I

06:25:58 assume they were the result of of
06:25:59 balancing other priorities.
06:26:02 Q. So ultimately, is it fair to
06:26:02 say that the Carter plan is comparable
06:26:04 to or matches all other plans on the
06:26:04 criteria of contiguity, population
06:26:06 deviation, compactness and subdivision
06:26:08 splits?
06:26:10 A. I wouldn't go so far as it is
06:26:12 comparable to or better on all of
06:26:14 those. But I --- yeah I wouldn't go
06:26:19 that far.
06:26:20 Q. Comparable or matches?
06:26:20 A. It is --- it splits the most
06:26:20 municipalities of the ones in
06:26:20 contention. So I wouldn't use that
06:26:32 sentence. But I --- I --- I think
06:26:34 it's ---if you are asking for my
06:26:35 evaluation of the plan overall, I
06:26:37 think this should be regarded in view
06:26:37 of it's superlative least change
06:26:37 score. And we heard testimony from
06:26:44 earlier that that was top of mind in
06:26:46 the design of that plan. It just laps
06:26:50 had field when it comes to least

change.

And so sometimes I like to think about the redistricting principles a little bit like a game of twister. If you have to put your hand on this dot and this foot over here and that foot over there, the more things you're trying to do, the less elegant you might look trying to do it.

Right?

And so these should be viewed in light of it's --- it's expressed goal and it's excellent performance in something not pictured, which is least change.

Q. Sure.

And circling back to subdivision splits, you didn't analyze VTD splits.

Right?

A. I did actually look at split VTDs, but I didn't report on it.

Q. But it is not in the report? Okay.

06:27:31 Moving onto least change
06:27:35 actually. Are you --- you are
06:27:36 familiar with the principal.
06:27:37 Correct?
06:27:38 A. Of least change?
06:27:39 Q. Yes?
06:27:41 A. I am.
06:27:41 Q. And can you just explain that
06:27:43 principle briefly?
06:27:44 A. Sure. It's a principal of
06:27:45 resemblance to a benchmark. And it's
06:27:49 typically assessed by making a
06:27:51 matching of District numbers between
06:27:53 two plans and then looking at the
06:27:54 number or the percentage of people who
06:27:57 are in the same district with respect
06:28:01 to an all plan.
06:28:02 Q. Okay.
06:28:02 And --- and in your second
06:28:03 report, you did not --- you didn't
06:28:04 analyze the proposed plans for least
06:28:06 change?
06:28:06 Correct?
06:28:07 A. I --- I think I mentioned in my
06:28:09 testimony that I --- I did compute

06:28:11 that. It's not in the report, but
06:28:15 that my findings agreed to the extent
06:28:17 that I was able to quickly compare
06:28:22 with the findings shown by Doctor
06:28:23 Rodden.
06:28:23 Q. Right. You testified to that
06:28:24 earlier.
06:28:24 Right?
06:28:25 And in your first report, you
06:28:25 acknowledge that the Pennsylvania
06:28:27 Supreme Court in it's 2018 League of
06:28:27 Women Voters' Opinion recognized the
06:28:27 principle of least change as a
06:28:27 traditional redistricting criterion to
06:28:27 be complied with after compliance with
06:28:36 the neutral traditional criteria?
06:28:37 A. My recollection is that it is
06:28:39 cited that something that can be
06:28:43 legitimately considered.
06:28:43 Q. And you also note that based on
this opinion in your first report,
that it would be reasonable to prefer
a plan that is least disruptive to the
2018 remedial plan.
Is that correct?

06:28:50 A. Yes. On least change, I think
06:28:52 it's reasonable to regard less as
06:28:54 better in this context.
06:28:55 Q. And you if further explained
06:28:56 that it is reasonable to prefer plans
06:28:58 with lower displacement from the
06:28:58 original plan given that is was put in
06:28:58 place by the court as a model of fair
06:29:02 districting?
06:29:02 A. Yes.
06:29:03 Q. And you state in your first
06:29:05 report that it would be reasonable
06:29:07 that --- to prefer plan that performs
06:29:09 best on that metric?
06:29:11 A. By the likes of all the others.
06:29:13 So if I could give a quick example. I
06:29:16 was recently working in Alabama in the
06:29:21 --- in the challenge to the
06:29:22 Congressional plan for which we just
06:29:22 had a decision last --- some time this
06:29:27 week. An in that case the question
06:29:29 was can you make an additional
06:29:32 majority/minority District. Well
06:29:33 doing so required quite a lot of
06:29:35 change over a map that didn't have

such a District. So it's unquestionable that least change can sometimes have to be sacrificed in order to achieve other things. So it --- it trades-,off especially with the creation of new kinds of districts. And so it trades-off with other principles.

ATTORNEY HOLCUM:

Your Honor, I pass the witness.

JUDGE MCCULLOUGH:

Okay. Thank you.

Now the --- Petitioner Gressman.

ATTORNEY HIRSCH:

Your Honor, Sam Hirsch for the Gressman Math and Science Petitioners.

CROSS EXAMINATION

BY ATTORNEY HIRSCH:

Q. Professor Duchin, our map is sometimes referred to as the Gressman

map or the GMS plan. Different names.

But anyway, wonderful to see you. In --- in the interest of full disclosure and because I might slip and actually call you Moon, you and I have worked together in redistricting litigation in other states.

Right?

A. We have and we're also co-authors on a published paper.

Q. Right. So we've worked together in North Carolina.

Yes?

A. We --- we did.

Q. In Wisconsin?

A. Yes.

Q. And we recently co-authored an article on computational redistricting and the Voting Rights Act.

Correct?

A. That's the one.

Q. That's the one.

Let's start by talking about what you refer to with Mr. Persily who drew the League of Women's Voter's map

06:31:17 for the Pennsylvania Supreme Court.
06:31:18 And you told the story about
06:31:20 how he kept Buffalo intact and then
06:31:24 caught all sorts of grief for it and
06:31:26 learned his lesson.
06:31:27 Do you know when that took
06:31:28 place?
06:31:28 A. If I remember right, and I wish
06:31:31 I had this in hand, I think that was
06:31:31 the 2000 redistricting.
06:31:33 Q. Yes, I believe that's right.
06:31:34 And so that was before --- before the
06:31:36 2018 map that he drew in Pennsylvania
06:31:38 for sure?
06:31:39 A. Oh, quite a bit before.
06:31:40 Q. And despite having caught all
06:31:42 that grief, he kept Pittsburgh in one
06:31:46 district in the 2018 map.
06:31:48 Correct?
06:31:51 A. Yes, he did. Definitely.
06:31:52 Q. And --- and are you aware of
06:31:55 the fact that there is no provision in
06:31:57 the New York State Constitution saying
06:31:59 that a city must be preserved intact
06:32:03 unless absolutely necessary?

06:32:06 A. I'm willing to believe you.
06:32:08 Q. But in the Pennsylvania
06:32:09 Constitution there is exactly that
06:32:11 provision, a provision that says no
06:32:13 county, city incorporated town,
06:32:17 borough, township or ward should be
06:32:21 divided among districts unless
06:32:24 absolutely necessary, something to
06:32:25 that effect.
06:32:25 Yes?
06:32:25 A. Something to that effect, yes
06:32:26 And I think if you take that very
06:32:27 literally, that is no individual city.
06:32:32 Q. I'm just asking if you're aware
06:32:34 of the provision of the State
06:32:35 Constitution?
06:32:36 A. Well I'm trying to describe my
06:32:38 understanding of it. I think it can't
06:32:40 be taken literally to say that no city
06:32:43 can be divided unless it must, because
06:32:47 then --- right, you see what I mean?
06:32:50 Q. Let's turn to your reports now,
06:32:53 Professor. Is it correct you filed a
06:32:55 response report yesterday?
06:32:56 A. Yes, I remembered.

06:33:00 Q. And in that report, you looked
06:33:02 at 13 plans submitted to the Court.
06:33:04 Correct?
06:33:05 A. Yes.
06:33:05 Q. And you wrote primarily about
06:33:07 two topics, first was an excellence
06:33:07 standard for traditional criteria,
06:33:07 like compactness and respect for
06:33:15 counties and municipalities?
06:33:16 A. Yes.
06:33:17 Q. And the second one was partisan
06:33:20 fairness.
06:33:21 Correct?
06:33:21 A. Yes, that is sounds right.
06:33:22 Q. And as the traditional criteria
06:33:24 you placed four plans out of the 13.
06:33:29 In the top tier plans that meet a high
06:33:31 excellent standard followed by two
06:33:34 more plans that also meet an
06:33:36 excellence standard.
06:33:37 Right?
06:33:37 A. I believe that is accurate to
06:33:45 how I phrased it.
06:33:45 Q. So out of 13 plans, that's 6
06:33:46 plans that you deemed excellent on

06:33:46 traditional criteria.
06:33:48 Correct?
06:33:48 A. Yes, I made what I termed
06:33:53 tiers.
06:33:53 Q. And turning to the other half,
06:33:57 the partisan fairness metrics, you
06:33:57 identified three plans as, quote,
06:33:59 dominating the field, but you just
06:34:01 explained a few minutes ago that you
06:34:02 had a very precise idea of what that
06:34:05 meant and I accept --- every time I
06:34:07 refer to that I'm accepting your
06:34:08 understanding of what dominating the
06:34:09 field meant. But it's correct that
06:34:11 there were three plans that you cited
06:34:13 for that.
06:34:14 Correct?
06:34:14 A. Three plans were dominated by
06:34:16 no other. That's correct.
06:34:18 Q. And the phrase dominating the
06:34:19 field is the one you used in the your
06:34:21 report. I understand that you may not
06:34:24 perfectly love that phraseology.
06:34:28 So the Governor's plan was the
06:34:29 only one that you deemed both

06:34:31 excellent on the traditional criteria
06:34:35 and dominating the field on the
06:34:37 partisan fairness metrics as we
06:34:40 described it.
06:34:40 Right? It's that intersection
06:34:42 of the two?
06:34:42 A. That's right. And I don't want
06:34:44 to overstate the, you know, perfection
06:34:49 of these classifications. I'd like
06:34:51 that to be understood.
06:34:51 Q. Sure.
06:34:51 A. But that --- by the likes of
06:34:54 that analysis it was the intersection
06:34:54 of those two.
06:34:54 Q. And my clients Gressman
06:35:01 Mathematicians and Scientist plan,
06:35:01 also known as the GMS plan did not
06:35:03 make it on to any of those lists that
06:35:05 we just described.
06:35:05 Correct?
06:35:06 A. That's correct. But I would
06:35:08 like to specify if ---.
06:35:09 Q. I'm sorry, I just asked you if
06:35:09 it's on any of those lists.
06:35:12 Is it on any of those lists?

06:35:15 A. No.
06:35:15 Q. So let's talk about first excellence on the traditional criteria. The six plans that you deemed excellent included the Citizens plan in the highest tier and the Reschenthaler 2 and Khalif Ali plans in the next tier.
06:35:32 Correct?
06:35:34 A. We can pull it up, but I'm willing to believe.
06:35:36 Q. Well, let's pull it up. Do I need to press this? I hope that's visible. We tried to blow that up.
06:35:47 This is Table 1 from your report. The only difference is I drew a line under our Gressman plan just because I'm going to be referring to it, and it's a little easier on the eye if you have a pointer.
06:35:57 So turning to this, the first tier excellent Citizens plan, which is second on that list had a worse Convex Hull compactness score than the GMS plan.

06:36:11 Right?
06:36:11 A. Convex Hull is an example where
06:36:15 higher and better ---.
06:36:15 Q. I'm sorry, I'm just asking you
06:36:16 a yes or no question.
06:36:17 A. I'm trying --- I'm trying to
06:36:19 work out the answer to your question.
06:36:20 So Convex Hull is a score of higher is
06:36:22 better, so I agree that Gressman is
06:36:24 better than Citizens on that.
06:36:25 Q. And the also excellent
06:36:27 Reschenthaler 2 plan did worse than
06:36:31 the GMS plan on both the Convex Hull
06:36:36 compactness score and the REOC
06:36:38 compactness score.
06:36:39 Correct?
06:36:39 A. Okay.
06:36:40 I will try to make the
06:36:43 comparison. Reschenthaler 2 is worse
06:36:44 on Convex Hull. And what's the second
06:36:49 one.
06:36:49 Q. REOC.
06:36:49 A. Let's see. Reschenthaler 2 is
06:36:54 worse on REOC. That's correct.
06:36:55 Q. And the also excellent Khalif

06:37:01 Ali plan did worse than the GMS plan
06:37:01 on both the Convex Hull compactness
06:37:01 score and the population polygon
06:37:01 compactness score.
06:37:01 Right?
06:37:12 A. So let's try. So population
06:37:13 polygon higher is better, so I agree
06:37:15 Gressman beats Khalif Ali. And remind
06:37:19 me the other.
06:37:19 Q. Convex Hull for Khalif Ali.
06:37:25 A. Convex Hull. I agree, yes.
06:37:26 Q. And that Khalif Ali plan,
06:37:29 that's the excellent plan on
06:37:29 traditional criteria that has more
06:37:30 than an 8,000 person census population
06:37:34 deviation.
06:37:34 Correct?
06:37:35 A. It depends on your basis for
06:37:37 balancing ---.
06:37:37 Q. Census?
06:37:38 A. Census population, yes.
06:37:40 Q. Yes.
06:37:41 A. I think that's the right way to
06:37:42 say it.
06:37:43 Q. And in turning to the political

06:37:44 subdivisions protected by the
06:37:46 Pennsylvania Constitution, is it
06:37:48 correct that the GMS plan has fewer
06:37:51 split counties on table one than the
06:37:55 excellent Governor's plan?
06:37:59 A. It does have fewer. Yes, 15
06:38:01 and 16.
06:38:01 Q. And the GMS plans also has
06:38:04 fewer county pieces than the
06:38:05 Governor's plan.
06:38:06 Right?
06:38:06 A. As you would expect.
06:38:06 Q. That was yes?
06:38:09 A. Yes.
06:38:10 Q. And the GMS plan has fewer
06:38:12 split municipalities than the
06:38:15 Governor's plan, too; doesn't it?
06:38:21 A. Yes.
06:38:21 Q. In fact the GMS plan ties or
06:38:22 beats all six of these standard of
06:38:23 excellence plans on split
06:38:26 municipalities.
06:38:27 Correct?
06:38:28 A. I'm willing to believe you.
06:38:29 I'd have to think it through.

06:38:31 Q. And the GMS plan also beats the
06:38:35 Governor's plans on municipal pieces.
06:38:37 Right?
06:38:38 A. Yeah. Again, that goes hand in
06:38:41 hand with splits.
06:38:41 Q. And the GMS plan ties or beats
06:38:44 every one of the six standards of
06:38:46 excellence plans on municipal pieces;
06:38:53 doesn't it?
06:38:53 A. Yes. It's tied for best of
06:38:54 all.
06:38:54 Q. Professor Duchin does the word
06:38:59 ward or the word wards appear anywhere
06:39:00 in either of your two expert reports?
06:39:02 A. We would have to search, but I
06:39:05 believe it did not make its way into
06:39:08 the reports.
06:39:08 Q. Professor Duchin, you're aware,
06:39:11 aren't you that the very same sentence
06:39:14 in the Pennsylvania Constitution that
06:39:16 prohibits the unnecessary splitting of
06:39:18 counties and municipalities which you
06:39:20 report on, says the exact same things
06:39:22 about wards.
06:39:23 Correct?

06:39:23 A. Yes.
06:39:23 Q. And Professor Duchin, you did
06:39:27 not include in your Table 1, a column
06:39:29 for split wards or a column for ward
06:39:33 pieces, did you?
06:39:34 A. I did not.
06:39:34 Q. Professor Duchin, at the time
06:39:37 you made the decision to omit wards
06:39:44 from Table 1, had you --- I want to
06:39:46 put this diplomatically --- had you
06:39:48 forgotten that the Governor's plan
06:39:52 split 25 wards while the GMS plan
06:39:55 split only 15?
06:39:55 A. I didn't do a ward computation
06:39:58 for the GMS plan. I did do a ward
06:39:58 computation for the original three
06:40:04 ---.
06:40:04 Q. So you had not. Did Counsel
06:40:10 for the Governor instruct you not to
06:40:12 report on wards?
06:40:13 A. No.
06:40:13 Q. All right.
06:40:14 Now that we've discussed your
06:40:15 tiers of excellence, I'd like to turn
06:40:21 to Table 2 of your response report.

06:40:22 Again, I drew a line under the
06:40:26 Gressman plan because it's of
06:40:28 particular interest here.
06:40:33 Now, this is where you analyze
06:40:34 partisan outcomes or partisan
06:40:37 performance by looking at 12 statewide
06:40:39 general elections.
06:40:39 Correct?
06:40:41 A. Yes.
06:40:41 Q. In this table you report how
06:40:43 many districts were carried by the
06:40:44 Democratic candidate in each of those
06:40:46 elections under each plan.
06:40:48 Right?
06:40:49 A. I wouldn't say carried, I would
06:40:50 say how many districts have more
06:40:52 Democrat votes, yes. The Democrat
06:40:56 wasn't actually running in the
06:40:57 District.
06:40:58 Q. Fair enough. So the first row
06:41:00 in this table shows the numbers for
06:41:04 the Governor's plan.
06:41:05 Right?
06:41:05 A. Yes.
06:41:05 Q. And the fifth rows show similar

06:41:06 numbers for the GMS --- equivalent
06:41:08 numbers for the GMS plan.
06:41:08 Right?
06:41:10 A. Yes.
06:41:10 Q. And all other things being
06:41:13 equal, an important qualification ---
06:41:14 if a plan has higher numbers in its
06:41:17 row, it might be more Democratic
06:41:19 favoring, and if a plan has lower
06:41:22 numbers in its row, it might be more
06:41:24 Republican favoring.
06:41:24 Fair?
06:41:26 A. You're dealing with a range of
06:41:27 numbers, and so typically just as we
06:41:30 were talking about before, some will
06:41:31 be higher and some will be lower. But
06:41:33 if it were higher in all numbers then,
06:41:36 yes, it would be more --- is that what
06:41:36 you mean?
06:41:36 Q. All things being equal, higher
06:41:38 numbers suggest a more Democratic
06:41:40 favoring map and lower maps suggest a
06:41:40 more Republican favoring map.
06:41:43 Correct?
06:41:43 A. I would go along with that if

06:41:45 it was higher across the board.
06:41:48 Q. So in the top left cell we see
06:41:48 the number ten. I just want to make
06:41:51 sure that means --- that means that
06:41:53 the Democratic candidate for Governor
06:41:55 in 2014 got more votes than his
06:41:59 opponent of ten of the 17
06:42:01 Congressional districts in the
06:42:02 Governor's plan.
06:42:04 Right?
06:42:04 A. Yes.
06:42:04 Q. Yes.
06:42:05 And if you go across that first
06:42:07 row, you'll see that each of these 12
06:42:08 elections, anywhere from 6 districts
06:42:11 from 11 districts in the Governor's
06:42:13 plan were ones that the Democratic
06:42:16 candidate out-polled his opponent.
06:42:18 Correct?
06:42:18 A. Six to 11 is what I see, yes.
06:42:20 Q. All right.
06:42:21 Now, because we work together I
06:42:23 know you have one of the fastest,
06:42:31 arithmetic brains ever seen, so I'm
06:42:31 going to put that to work now. If we

06:42:31 go across that row and total those up
06:42:31 --- and you can take a second and do
06:42:31 this, or we can do it together, and we
06:42:35 add up those numbers, what would be
06:42:35 the sum of those 12 numbers in that
06:42:35 first row of table two that explains
06:42:42 or describes the Governor's plan?
06:42:44 A. I always say when I teach these
06:42:46 you shouldn't try to do arithmetic in
06:42:49 front of an audience, so I'm not sure.
06:42:53 But if you have that precomputed I
06:42:55 have every reason to believe that
06:42:58 you've done it right.
06:42:58 Q. Well, if you're willing to
06:42:58 accept my representation, the answer
06:43:00 is 111 across 12 elections, which
06:43:00 sounds about right when you look at
06:43:00 it.
06:43:04 A. Definitely ---.
06:43:04 Q. All right.
06:43:04 I'm not going to ask you to do
06:43:05 it for fifth row either?
06:43:08 A. I'm sorry, did you say 111.
06:43:10 Q. 111.
06:43:10 A. Yeah.

06:43:12 Q. You accept that?
06:43:12 A. In fact, I remember that, having done that in the past. That sounds right.
06:43:15 Q. Thank you.
06:43:16 Well, it turns out if you do the fifth row, it is also 111. You're welcome to check that if you'd like?
06:43:26 A. I believe that to be correct.
06:43:27 Q. So the difference between the number of districts where the Democratic statewide candidates in these 12 elections got the most votes in the Governor's plan versus in the GMS plan is 111, minus 111, and although I'm not as good a mathematician as you, that might be a difference of zero.
06:43:47 Correct?
06:43:48 A. That sum is what I sometimes call the aggregate proportionality, so yes, they're equal in aggregate.
06:43:54 Q. Thank you. Let's turn to Table 3 of the same report. Now
06:44:06 Professor, this is your and the total

efficiency gap for the Governor's plan.

Right?

A. That's right.

Q. And that number is .1007.

Right?

A. Yes.

Q. And am I correct that of the other dozen plans listed in this table. The one with the closest score to that is the Senate Democratic Caucus 2 plan and the second closest is the GMS plan?

A. That looks correct.

Q. And let's go over to the right-hand column which is for total partisan bias, am I correct that the closest score to the Governor's plan in that column is also the GMS plan?

A. It's hard to read, but I trust my coloring so, yes. Wait. Hang on. GMS is closest to the Governor's scores?

Q. Yes.

A. Isn't the House Dem caucus .1

06:44:58 --- oh that's positive.
06:45:00 Yes. I agree with you.
06:45:00 Q. Yes. So and let's now turn to
06:45:03 the second column, the total AGIA
06:45:06 metric. And in that one, isn't it the
06:45:08 exact same score for the GMS as for
06:45:09 the Governor's plan minus 0.0486 our
06:45:13 two four decimal places?
06:45:14 A. Yes. So to this degree of
06:45:15 precision they are equal.
06:45:17 Q. But the GMS plan is not one of
06:45:19 the three plans that you report
06:45:22 dominated the field according to these
06:45:26 partisan fairness metrics.
06:45:26 Correct?
06:45:26 A. That's just a fact, based on
06:45:27 these numbers.
06:45:28 Q. But the Carter plan was one of
06:45:29 those three, as was just discussed
06:45:32 with the Carter attorney?
06:45:33 A. Yes.
06:45:36 Q. And on all these scores, you
06:45:38 already mentioned that being closer to
06:45:39 zero is better?
06:45:40 A. Yes.

06:45:40 Q. But the GMS plan has a score
06:45:41 closer to zero and thus better than
06:45:46 the dominating Carter plan on the
06:45:46 total AGIA metric.
06:45:48 Correct?
06:45:52 A. Okay. Hang on.
06:45:52 Q. GMS is closer to zero than the
06:45:57 Carter plan on total AGIA.
06:45:57 A. I'm just checking. Yes, it is.
06:45:59 Q. And the GMS plan is closer to
06:46:00 zero than the dominating Carter plan
06:46:02 on total mean median.
06:46:03 Correct?
06:46:05 A. Yes. Probably on all, but one.
06:46:08 Q. Indeed, it's closer to zero on
06:46:11 total partisan bias as well.
06:46:13 Correct?
06:46:14 A. I believe it is.
06:46:15 Q. So as you just mentioned, the
06:46:15 GMS plan outperforms the Carter plan,
06:46:15 one of the three dominant ones on
06:46:19 partisan fairness metrics on three out
06:46:21 of the four partisan fairness metrics.
06:46:25 Correct? I think you just said
06:46:26 that?

06:46:27 A. Can I explain what dominating
06:46:29 means?
06:46:29 Q. No. You've already talked
06:46:32 about that.
06:46:33 A. Okay.
06:46:35 Q. Professor Duchin, I see my time
06:46:35 is almost up. So in the interest of
06:46:35 that, in the very last sentence of
06:46:38 your last report, did you conclude by
06:46:39 saying that the Governor's plan is ---
06:46:39 I'm going to quote now from the last
06:46:45 sentence of your last report, the
06:46:45 Governor's plan is not, not the only
06:46:48 reasonable choice as the best plan
06:46:52 before the Court?
06:46:53 A. Absolutely. I'm so glad you
06:46:55 gave me a chance to say that.
Q. Thank you.
A. I think the Gressman plan is an
excellent plan.

ATTORNEY HIRSCH:

Your Honor, I have no
06:47:03 further questions and I pass the
06:47:04 witness.

06:47:04 JUDGE MCCULLOUGH:

Okay.

CROSS EXAMINATION

BY ATTORNEY VANCE:

Q. Good afternoon, Doctor Duchin.

A. Hello.

Q. I want to start by just confirming a point in your report, which is you've opined that the Congessional districting plan passed by the General Assembly or passed by the Pennsylvania House of Representatives, HB-2146 is population balanced and contiguous, shows strong respect for political boundaries, and is reasonably compact.

Correct?

A. You're asking if that's what I wrote?

Q. Correct.

A. We can take a look and I can be sure.

Q. Do you have not have a copy of your report?

06:48:18 A. What page are we on?
06:48:18 Q. If you want to look at page two of your report?
06:48:18 A. Sure.
06:48:19 Q. If you look in the very first paragraph?
06:48:21 A. Yes, that is exactly what it says.
06:48:24 Q. But HB-2146 does not meet your quote unquote excellence standard.
06:48:26 Correct?
06:48:33 A. That's right.
06:48:34 Q. But, in fact, on splits, and whether you are looking at it by counties, by municipalities, by precincts, and by total splits, HB-2146 is in fact better than the Governor's plan.
06:48:34 Correct?
06:48:38 A. On splits it's better.
06:48:40 Q. So the only criteria of what the Governor's plan is better is compactness.
06:48:42 Correct?
06:48:45 A. Right. I think possibly all
06:48:49
06:48:49
06:48:50
06:48:52
06:48:54
06:49:02
06:49:02
06:49:02

six metrics of compactness. We can check.

Q. And part of the reason the Governor's plan can achieve a higher compactness score is because it splits the City of Pittsburgh.

Right?

A. It's one of many factors that contributes to the scores.

Q. Does splitting the City of Pittsburgh allow for the creation of two Democratic leaning seats as opposed to one?

A. To answer that, I'd have to look at the seats surrounding it in plans that keep it whole. And that's not an specific analysis that I've done to say that it's two instead one.

Q. You didn't look at that?

A. I didn't look at whether the district surrounding the one that contains Pittsburgh specifically would be Democratic leaning.

Q. Who drew the Governor's plan?

A. I'm not sure and I wasn't

06:49:58 involved in the drawing of the lines,
06:49:59 but my understanding is that it was
06:50:02 internally drawn in the Governor's
06:50:04 office.
06:50:04 Q. But you're not aware who
06:50:07 actually internally in the Governor's
06:50:08 office was responsible for drawing it?
06:50:10 A. Definitely not.
06:50:10 Q. Do you know partisan data was
06:50:11 used in the drawing of the Governor's
06:50:12 plan?
06:50:13 A. In the drawing of --- I
06:50:14 couldn't speak to that.
06:50:18 Q. So the Governor, to your
06:50:20 knowledge, has not made public who
06:50:22 actually drew his plan, has he?
06:50:25 A. To my knowledge that's not
06:50:26 public.
06:50:27 Q. And the Governor's plan has not
06:50:28 gone through any sort of legislative
06:50:32 practice, has it?
06:50:34 A. That's right. It has not, to
06:50:37 be clear.
06:50:37 Q. Do you know when the Governor
06:50:39 first made his plan public?

06:50:44 A. It would be in the last few
06:50:47 weeks. It was posted publicly on the
06:50:49 same portal that took public feedback,
06:50:52 but I can't remember the exact date.
06:50:54 Q. If I represented to you that it
06:50:56 was January 15th, does that sound
06:50:57 about right?
06:50:58 A. That does sound reasonable.
06:50:59 Q. Are you aware of when HB-2146
06:51:02 was first made public?
06:51:03 A. In that forum, I'm not sure.
06:51:05 But I know that it's one of a number
06:51:08 of maps. There were a number of maps
06:51:10 drawn by Amanda Holt and made public
06:51:13 over a long period of time and this is
06:51:15 a modification of one of them.
06:51:20 Q. Doctor Duchin, I assume you
06:51:21 agree that district lines should not
06:51:23 be drawn to intentionally give a
06:51:25 benefit to one political party at the
06:51:28 disadvantage to another.
06:51:29 Correct?
06:51:32 A. I agree that plans should not
06:51:34 be drawn to maximize partisan
06:51:38 advantage.

06:51:38 Q. Now, you state that HB-2146
06:51:39 systematically advantages one
06:51:40 political party over the other,
06:51:41 largely due to the political geography
06:51:43 of Pennsylvania.
06:51:44 Correct?
06:51:45 A. I can't say that it's due to
06:51:47 that in the substantiation of the one
06:51:51 plan, but I would say that blindly
06:51:54 drawn plans tend to have that property
06:51:56 due to the political geography and the
06:51:57 rules of Pennsylvania.
06:51:58 Q. And that perceived political
06:52:02 advantage, that exists before anyone
06:52:04 even starts drawing any lines.
06:52:05 Correct?
06:52:08 A. It's a combination of the lines
06:52:10 and the votes.
06:52:10 Q. But it's based upon where the
06:52:13 voters live, where voters with certain
06:52:15 preferences have, where they live and
06:52:17 where they're located?
06:52:18 A. It's definitely a function of
06:52:21 that together with the rules of
06:52:23 redistricting.

06:52:23 Q. And I think, as you've opined,
06:52:25 the concentration of Democrats creates
06:52:27 a landscape that is tilted towards
06:52:31 Republicans.
06:52:31 Correct?
06:52:32 A. To be clear, and this is
06:52:33 something I published and think about
06:52:34 a lot, it's not just the
06:52:36 concentration. It's the location.
06:52:41 It's the spacial arrangement.
06:52:41 Q. And as I understand it, one of
06:52:44 the purposes or at least benefits of
06:52:45 the Governor's plan in your opinion is
06:52:48 that it over comes this tilt. Is that
06:52:53 fair?
06:52:54 A. Yes.
06:52:54 Q. And in fixing this tilt, that's
06:52:56 something that benefits the Democrats.
06:52:58 Correct?
06:52:59 A. My view is that it benefits all
06:53:01 Pennsylvanians to have plans that are
06:53:03 responsive and fair.
06:53:04 Q. But particularly, it's going to
06:53:06 be more likely to result in a better
06:53:08 chance for Democrats to win additional

seats or to achieve more Democratic leaning seats. Isn't that true?

A. Only if the votes go that way. It's a function of the votes.

Q. So in drawing lines to specifically negate this tilt, isn't that drawing lines specifically to benefit one political party over the other?

A. Oh, I think not. So that's actually pivotal to this analysis is that something these metrics are trying to guide you to is treating the parties evenhandedly.

Q. But by evenhandedly, you're saying you have to get rid of a natural advantage that the Republicans have.

Correct?

A. By evenhandedly, I mean the party with more votes should tend to more seats and that cuts both ways.

Q. But in order to do that, you need to negate this Republican tilt that you recognize?

06:54:04 A. Yeah, and I'm really trying to
06:54:06 answer the question responsively. So
06:54:09 the --- in Pennsylvania, there is a
06:54:10 structural advantage towards
06:54:12 Republicans and getting to better
06:54:14 partisan fairness does require you to
06:54:16 overcome that.
06:54:16 Q. You're not here saying it's
06:54:18 going to benefit Republicans by
06:54:19 getting rid of the structural
06:54:21 advantage, are you?
06:54:23 A. In the long-term, it might be
06:54:24 beneficial. But in the short-term
06:54:27 based on the recent elections that I
06:54:29 analyzed certainly, certainly it's the
06:54:31 case that it gives a better chance for
06:54:33 Democrats to be elected.
06:54:35 Q. Is it appropriate to ignore
06:54:37 traditional redistricting criteria to
06:54:41 negate a tilt or some advantage that
06:54:42 results because of the political
06:54:44 geography of a state?
06:54:47 A. To ignore, certainly not.
06:54:48 Q. But where is that line then?
06:54:50 What if it requires you to split more

than five counties in it than an average plan in order to negate that tilt? Would that be appropriate?

A. This is what I've sometimes called a trade-off zone. And so a little bit of trading off is inevitable. But when you're far behind other options, then I think that's notable in analysis like the one that I've conducted.

Q. So if a plan had to split five more counties, then all the other plans in order to negate this natural tilt, would that be appropriate?

A. In the context of these specific plans, I think five additional county splits would be something that you sort of need to see a great path in many other principles in order to --- to account that.

Q. What about three county splits?

A. This is a speculation that's really hard to entertain without looking at concrete examples.

Q. So you can't tell us where that

line would be?
A. I will repeat, and very sincerely, that most of these matters have no bright line.
Q. Now, Doctor Duchin, according to your report, you prepared a simulation where you created an ensemble of 100,000 different maps.
Correct?
A. Well, I think the word simulation is a misnomer here. They're not imaginary plans. They're real plans. They're real districting plans. So I prefer to call it a sampling process.
Q. As I heard you earlier, you believe that Doctor Barber didn't provide a lot of detail about his methodology in his report, but you don't provide any detail about your methodology anywhere in your reports, do you?
A. About the methodology for the plans, I think I'm on the record and everything's open source.

06:56:35 Q. But there's nothing in your
06:56:36 reports about the methodology you used
06:56:38 to create these on ensemble of 100,000
06:56:42 plans, is there?
06:56:42 A. The graph algorithm is not
06:56:45 described in the reports.
06:56:45 Q. But not just the algorithm,
06:56:47 Doctor Duchin. You don't report
06:56:48 anything about the population
06:56:50 deviation threshold you used, do you?
06:56:51 A. We'd have to look, but I
06:56:52 believe you. If you represent that I
06:56:53 did not, I believe you.
06:56:54 Q. You don't report about any
06:56:56 minimum or maximum compactness scores
06:57:03 you may have used?
06:57:04 A. I don't. I certainly don't
06:57:04 because there's no such thing in the
06:57:05 method.
06:57:05 Q. You didn't report how you went
06:57:07 about trying to minimize political
06:57:09 subdivision splits?
06:57:11 A. No.
06:57:15 Q. Now, I assume you agree that
06:57:24 when you you use different sets of

elections data, you can get different outcomes.

Correct?

A. I've actually testified to that.

Q. And my understanding is you have a criticism of Doctor Barber because he uses what we call an index of elections.

Is that fair?

A. I think it's misleading. So yes, that is fair.

Q. And I think you said in your report and testified to earlier, one of the reasons you don't like an index is because if you have big swings in election outcomes, it can really skew the results.

Is that fair?

A. To be precise, it erases and makes invisible the difference between something responsive and something stable.

Q. But as Doctor Rodden showed in his report, we don't have big massive

swings in Pennsylvania elections, do we?

A. Well, if we look at the elections in the data set that I analyzed, which is the same as I believe, the same as Doctor Barber's 11 elections, plus an additional one from 2014, I think the range was from about 59 percent Democratic to about 53 percent Republican. That's a pretty substantial range.

Q. A couple of percentage points to you is a substantial range?

A. That's 12 percentage points.

Q. I'm sorry. I thought you said --- maybe I misheard what you said.

A. Fifty-nine (59) one way to 53 the other is 12 percentage point.

Q. I understand what you're saying now. Okay.

A. That's an approximation. We could look at the actual numbers if it would be helpful.

Q. Now, you also don't report the predicted number of Democratic leaning

seats and Republican leaning seats for each of your simulations, do you?

A. For each of the maps in my ensemble? I --- actually that information is contained in the report. It's in, let's see if I can find it, the violin plot of the efficiency gap. So for people who know the metrics, as I assume that all these experts do, you can read the seats outcome off the efficiency gap fund.

Q. Can you explain that further?

A. Oh, sure. Gladly.

So the efficiency gap is closely related to twice the votes, minus the seats, minus the half. So in other words, there's this combination of seats and votes that gives you the efficiency gap up to a factor that has to do with relative turnout. So up to this sort of turn out factor, you can just convert efficiency gap to seats if you know the votes total for each election.

06:59:59 Q. Now, as I understand what
07:00:03 you're saying is that you agree that
07:00:03 the random plans that are drawn in
07:00:03 your ensemble without any partisan
07:00:07 data, Exhibit A, pronounced advantage
07:00:09 to Republicans.
07:00:10 Correct?
07:00:10 A. That's a qualitative
07:00:12 assessment, but I would call this
07:00:14 pronounced.
07:00:15 Q. You would call it pronounced?
07:00:17 A. I would.
07:00:17 Q. Okay.
07:00:22 And so, again, you have to
07:00:23 intentionally draw a plan to correct
07:00:25 for that advantage?
07:00:26 A. No. You don't have to
07:00:28 intentionally draw it to correct for
07:00:30 that. You can draw it neutrally and
07:00:32 then select for that.
07:00:33 Q. But Doctor Duchin, I think both
07:00:35 your report and Doctor Barber's report
07:00:39 show if you draw a bunch of maps using
07:00:41 a computer without, which is using
07:00:43 traditional redistricting criteria and

07:00:44 not using any partisan data, you
07:00:47 result in a bunch of maps that have a
07:00:50 Republican tilt as you call it.
07:00:52 Correct?
07:00:53 A. So that's a mistake. That's
07:00:54 the most typical outcome. But when
07:00:56 you draw enough plans, you will have
07:00:59 thousands that have better partisan
07:00:59 fairness properties
07:00:59 Q. But the most typical outcome is
07:01:01 plans with a Republican tilt.
07:01:02 Fair?
07:01:03 A. Absolutely. And I'm not aware
07:01:05 of any rule that requires that we pick
07:01:08 the most typical. I think we're
07:01:09 trying to choose an excellent plan.
07:01:09 Q. So you would pick a plan that
07:01:12 does not go with the most typical
07:01:14 outcome?
07:01:15 A. So the analogy that I gave
07:01:18 earlier is to compactness. I wouldn't
07:01:21 prefer a plan over typical compactness
07:01:24 score. I would prefer an excellent
07:01:26 compactness score.
07:01:27 Q. Turning to page 19 of your

report, Doctor Duchin. You were looking at this earlier with counsel in your partisan bias. And as I understand it in that chart, all of the dots that represent the Governor's plan are all on the most Democratic leaning portion of your violin plot.

Correct?

A. Yes. Let's check.

Q. All with the exception ---

A. Not the first.

Q. --- of the 2014 election?

A. Yeah. It looks like 2014, Governor is in the second visible position. And then the others are --- I'm reviewing now. The others are in the last visible position.

Q. So this means, Doctor Duchin, that with the exception of one election, so for the 11 of the 12 elections you looked at, the Governor's plan produces a higher partisan bias for Democrats than nearly all of the ensemble maps.

Correct?

07:02:31 A. No, a lower partisan bias.
07:02:33 That's the thing. Zero here is the
07:02:36 lowest. And so it produces --- I
07:02:39 agree with almost every piece of your
07:02:41 sentence, except that the other
07:02:43 direction. It's that in almost every
07:02:46 election, it produces the lowest
07:02:48 partisan bias level available.
07:02:50 Q. You're saying a partisan bias
07:02:55 when compared to zero.
07:02:55 Correct?
07:02:56 A. That's how it works.
07:02:56 Q. But when you compare it to the
07:02:56 ensemble of maps, it's more
07:02:57 pro-Democrat than almost all of the
07:02:57 ensemble of maps on partisan bias.
07:03:00 Correct?
07:03:00 A. I don't think that's the right
07:03:02 way to summarize what we see here.
07:03:04 Q. Well, how else would you
07:03:06 describe that the purple dots being on
07:03:07 the very top part of this graph? It
07:03:12 is an outlier when compared to the
07:03:14 ensemble of maps, is it not?
07:03:15 A. We agree that it's an outlier.

Q. An outlier in the favor of Democrats?
A. I can't agree with that. An outlier in favor of minimal partisan bias.
Q. When you're comparing it to zero?
A. Yes.

ATTORNEY VANCE:

No further questions. Thank you, Your Honor.

ATTORNEY GORDON:

Preparing in a hotel room and there are a lot of papers that you've to walk around with.

THE WITNESS:

I understand.

CROSS EXAMINATION

BY ATTORNEY GORDON:

Q. Okay.
So I represent the Congressional Intervenors. Reschenthaler 1 and Reschenthaler 2 is

what we submitted to the Court?

JUDGE MCCULLOUGH:

Counsel, you can take off your mask?

ATTORNEY GORDON:

Oh, delightful.

BY ATTORNEY GORDON:

Q. Just real quick while I'm thinking about it, on Table 4.3 that you were just talking about, at the bottom there's an ensemble mean. Do you happen to do an ensemble range?

A. Do you have a page number?

Q. It is page four of your last report of yesterday's report.

A. Yes, the red and blue table. Yes, that's the one.

Q. Do you have a range as opposed to a mean for the ensemble line?

A. I certainly have it available in my data. But since I didn't put it in the report, I don't know it by heart.

Q. Fair enough.

And are these numbers percents

07:04:38 that are in this table?
07:04:40 A. Oh, okay. Good question. So
07:04:42 what are the units of these numbers.
07:04:44 Q. Yes.
07:04:44 A. Yeah, okay. It varies. So
07:04:46 efficiency gap is in terms of wasted
07:04:50 votes over total votes. So you can
07:04:52 interpret that as a vote share.
07:04:54 Q. Is that a percent?
07:04:58 A. If you --- it's not a percent.
07:04:58 It's a share. So the number 1 would
07:04:58 be 100 percent. But it's --- you can
07:05:01 ---.
07:05:01 Q. And I'm really only concerned
07:05:03 with that first column and here's why.
07:05:03 A. Sure.
07:05:05 Q. When Professor Persily
07:05:05 presented to the Pennsylvania Supreme
07:05:13 Court in 2018, he talked about his
07:05:14 model, then he talked about percent
07:05:16 range. So I'm just trying to make a
07:05:18 one to one.
07:05:18 A. Sure.
07:05:18 Q. And he said in his range, it
07:05:19 was .1 to 4.5 percent. So I'm just

07:05:24 trying to translate your ---.
07:05:24 A. Let me help you with that.
07:05:26 Q. Yes.
07:05:26 A. So if you wanted to turn these
07:05:28 into something comparable to an
07:05:29 individual election, you'd need to
07:05:30 divide by 12 because this is the sum
07:05:32 over 12 elections.
07:05:33 Q. So if you divide by 12, you get
07:05:35 a percent?
07:05:36 A. Yes. Then you can interpret it
07:05:39 that way.
07:05:40 Q. Lovely. Okay. Now I'm on
07:05:41 board. All right. I'm learning as I
07:05:43 go. This is some fancy math.
07:05:45 A. I guess.
07:05:46 Q. We've heard you say, but I just
07:05:49 want to make sure it's clear. The
07:05:51 best plan before the Court is in your
07:05:54 opinion is the Governor's plan.
07:05:56 Is that correct?
07:05:57 A. I think a term like best, you
07:06:02 know, it is in the intersection of two
07:06:03 ways of slicing the maps and it's the
07:06:06 only plan that is so. I think it's an

07:06:08 excellent map.
07:06:08 Q. And frankly, I'm just quoting
07:06:11 the terminal sentence from your report
07:06:11 ---
07:06:11 A. Sure.
07:06:13 Q. --- where you declare it to be
07:06:13 the best.
07:06:13 A. Well then, let's go with that.
07:06:15 Q. Fair enough. And you realize
07:06:16 you're the third expert today to give
07:06:19 the third opinion on which one's the
07:06:21 best?
07:06:21 A. I am sure that there will be as
07:06:23 many opinions as there are experts.
07:06:25 Q. I agree. Okay.
07:06:26 So let's look at your report. Are you
07:06:29 confident in the numbers that are in
07:06:30 this report?
07:06:31 A. I'm glad you asked that. It
07:06:32 can be really hard to produce good
07:06:34 numbers under time pressure.
07:06:34 Q. Uh-huh (yes).
07:06:37 A. But I have an excellent team of
07:06:39 research assistants and we subjected
07:06:41 these numbers to really rigorous

07:06:44 checks. So I am very confident.
07:06:45 Q. Very good. All right.
07:06:47 So 2B, excuse me, Section 31,
07:06:50 you talk about all plans are
07:06:55 contiguous. That includes
07:06:57 Reschenthaler 1 and Reschenthaler 2.
07:06:58 Correct?
07:06:58 A. Yes.
07:06:58 Q. And closely population balance,
07:07:01 that includes Reschenthaler 1 and
07:07:02 Reschenthaler 2.
07:07:02 Is that correct?
07:07:03 A. Yes.
07:07:03 Q. Okay.
07:07:04 And then you analyze the compactness,
07:07:08 and hopefully I can short circuit
07:07:10 this. You would agree that
07:07:10 Reschenthaler 1 and Reschenthaler 2
07:07:12 are compact?
07:07:13 A. Yes, and I'm looking just to
07:07:15 verify. Yes, they are. They are
07:07:22 reasonably compact.
07:07:23 Q. Okay.
07:07:23 And we'll look at our county
07:07:26 splits there just for Reschenthaler 1

and Reschenthaler 2. You would agree with me that Reschenthaler 1 and Reschenthaler 2 split 13 counties?

A. Yes.

Q. And you would agree with me that's the lowest county split of all the maps that you reviewed?

A. Yes, I would characterize that as aggressive pursuit of county integrity.

Q. That's what we're going for.

A. Yeah.

Q. And county pieces 29, also the lowest number.

Is that correct?

A. Yes. Those are closely related.

Q. Uh-huh (yes). And then municipal splits, 16 tied for the lowest?

A. That's correct.

Q. And 33 also tied for the lowest in terms of municipal pieces.

That's correct?

A. Yes.

07:07:59 Q. Okay.

07:08:00 So do you agree with me that a
07:08:02 17 district compact, contiguous, and
07:08:06 equal population map can be drawn with
07:08:08 just 13 county splits?
07:08:10 A. Well, I think it can be drawn
07:08:12 with fewer if you're willing to
07:08:15 sacrifice compactness a little bit
07:08:18 more.
07:08:18 Q. But would you agree that could
07:08:19 be done with 13?
07:08:20 A. You'd have to tell me what the
07:08:21 threshold is for reasonable
07:08:22 compactness. I am trying to answer
07:08:24 your question truly.
07:08:24 Q. I think the answer --- well,
07:08:26 it's your question to answer. But
07:08:28 what I think we just went through is
07:08:30 you agreed ours were compact,
07:08:31 contiguous, and equal population that
07:08:33 had 13 districts. So I think you
07:08:37 agree it can be done.
07:08:38 Is that right?
07:08:38 A. The problem is that compactness
07:08:41 is a graduated phenomenon.

07:08:41 Q. Is Reschenthaler 1 and
07:08:43 Reschenthaler 2 compact?
07:08:45 A. It's reasonably compact, but
07:08:46 others are more compact.
07:08:48 Q. That's not the question. The
07:08:50 question is, and I'll repeat it. Do
07:08:52 you agree a 17 district map can be
07:08:55 drawn that is compact, contiguous,
07:08:58 equally populations and splits just 13
07:08:58 counties?
07:09:00 A. Add the word reasonably compact
07:09:02 and I agree.
07:09:02 Q. Reasonably compact?
07:09:03 A. Yes, I agree.
07:09:04 Q. Ideal. Okay.
07:09:05 Same question. Do you agree that a 17
07:09:08 district compact, reasonably compact
07:09:11 if nothing else, contiguous and equal
07:09:14 population can be drawn with just 16
07:09:16 municipal splits?
07:09:18 A. Yes.
07:09:18 Q. Okay. All right.
07:09:21 So I just want to quick go
07:09:23 through this chart, and we'll just
07:09:25 focus on Reschenthaler 1. If you go

07:09:27 through this chart, there's ten lines.
07:09:29 And I will ask the question, and then
07:09:33 if you need help, I'll tell you what
07:09:35 the answer is. But would you agree
07:09:37 with me that Reschenthaler 1 beats the
07:09:39 Governor's map on seven of the ten
07:09:42 columns in this chart?
07:09:43 A. We're still on table one.
07:09:45 Right?
07:09:46 Q. We are indeed.
07:09:47 A. Okay. Okay.
07:09:48 Let's check. We're talking
07:09:49 Reschenthaler 1 versus Governor?
07:09:51 Q. Uh-huh (yes).
07:09:53 A. Okay.
07:09:59 I bet that that's --- so you
07:10:01 said seven out of the ten?
07:10:02 Q. Correct.
07:10:02 A. Yeah. I think you'll find the
07:10:02 Governor's plan better on three
07:10:02 compactness scores and Reschenthaler
07:10:07 better on the other three compactness
07:10:08 scores and on the splitting scores.
07:10:10 Q. So across the board, seven out
07:10:12 of ten. And just on the compactness

07:10:14 scores, three to three?
07:10:15 A. I think that's right.
07:10:16 Q. Okay.
07:10:16 And just so the record's clear,
07:10:16 Pawsbee, Schwartz, Reok, Kahn, Holl,
07:10:20 Popolli, we want the top number, and
07:10:26 then the last one, we want the bottom?
07:10:29 A. Schwartzburg also you want a
07:10:31 smaller number.
07:10:31 Q. Schwartzburg you want smaller?
07:10:37 A. Yeah.
07:10:37 Q. Okay. All right.
07:10:38 A. Does that change the count?
07:10:40 That might change ---.
07:10:40 Q. That does change the count.
07:10:40 A. Oh, okay.
07:10:42 Q. Let's let the record be clear,
07:10:44 six out of ten. And that's why we ask
07:10:46 the questions, to make our record.
07:10:46 A. I'm glad we went through it.
07:10:48 Q. All right.
07:10:49 I want to flip to the, back to
07:10:52 that first table, table three in your
07:10:54 report. Which of these maps that's
07:11:01 reflected in this chart under the

07:11:03 partisan fairness metrics, which one
07:11:05 has the least splits, least county
07:11:09 splits?
07:11:10 A. Sorry. Which table are we on?
07:11:12 Q. Four point or Section 4.3,
07:11:15 Table 3.
07:11:15 A. Yes. And the question again?
07:11:17 Q. And which maps in that chart
07:11:19 have the least county splits?
07:11:23 A. Those are not recorded here.
07:11:24 We can refer back and say
07:11:26 Reschenthaler 1, 2 of all the 13 maps
07:11:29 have the fewest county splits.
07:11:33 Q. And you would agree that in
07:11:34 this chart, again table three, the two
07:11:36 maps with the least municipal splits
07:11:39 tied is Reschenthaler 1 and
07:11:40 Reschenthaler 2?
07:11:42 A. Slight astricks. Since the
07:11:44 ensemble is in this table, the
07:11:44 ensemble probably contains things with
07:11:45 fewer splits.
07:11:45 Q. And my question is solely about
07:11:48 the maps that were submitted for
07:11:49 review.

07:11:50 A. Then yes.
07:11:51 Q. Okay. Very good.
07:11:53 So if you changed the county
07:11:54 splits for all these other maps to
07:11:56 make them just 13, would their scores
07:11:58 in this chart change?
07:12:00 A. Well, that's a great question.
07:12:01 Q. And it's just a yes or no
07:12:03 question.
07:12:03 A. But it's not.
07:12:03 Q. I know you want to explain why.
07:12:03 A. I can't.
07:12:05 Q. It's just yes or no.
07:12:06 A. If you want yes or no, it's
07:12:09 neither yes nor no.
07:12:10 Q. So your representation to the
07:12:12 Court is if these maps changed or
07:12:14 produced fewer county splits, the
07:12:16 scores don't change?
07:12:18 A. They might remain unchanged.
07:12:19 Q. They might remain unchanged,
07:12:19 but they might change?
07:12:29 A. But they might change.
07:12:30 Q. Indeed.
07:12:36 A. I agree.

07:12:36 Q. Okay.

07:12:36 Do you think fairness is the same thing as neutrality when we're talking about the drawing of district maps?

07:12:43 A. I do not.

07:12:43 Q. You do not? In fact, you emphatically do not.

07:12:46 Is that right?

07:12:48 A. Well, I do not think of them as the same.

07:12:51 Q. Okay.

07:12:51 Do you recall doing an interview for Political Magazine in May of last year, May 27th?

07:12:54

07:12:57 A. I believe you that it was May.

07:12:58 Q. Yes. And do you recall seeing that article where that very same question was asked and your response was emphatically not?

07:12:59

07:13:01

07:13:03

07:13:11 A. Right. That sounds totally reasonable.

07:13:12 Q. Okay.

07:13:12 Does the efficiency gap take into account political geography?

07:13:14

07:13:16

07:13:24 A. Can you rephrase that? I want
07:13:26 to answer it exactly.
07:13:28 Q. When you're calculating the
07:13:29 efficiency gap, is there any part of
07:13:34 variables that account for political
07:13:37 geography or human geography of a
07:13:37 party? It's called a couple things
07:13:37 today.
07:13:39 A. In a sense because it matters
07:13:40 where the district lines are and
07:13:41 you're assessing it with respect to an
07:13:45 election. So it does look at how the
07:13:47 lines compare to the votes. Is that
07:13:47 what you mean?
07:13:47 Q. Is it one of the variables in
07:13:51 the equation?
07:13:53 A. Yes. It goes into the variable
07:13:54 of wasted votes.
07:13:54 Q. That where people live ---
07:13:54 A. Yes.
07:13:55 Q. --- in relation to the
07:13:57 Commonwealth?
07:13:57 A. Yes.
07:14:13 ATTORNEY GORDON:
07:14:13 Okay. All right.

07:14:13 Well, boy, I hate to give up four and a half minutes, but I'm going to. That's all the questions I have, Your Honor. Thank you for your time.

JUDGE MCCULLOUGH:

Thank you, Counsel. Now we'll move to counsel for Representative McClinton.

CROSS EXAMINATION

BY ATTORNEY SENOFF:

Q. Thank you. This is David Senoff. I represent Representative McClinton and the Pennsylvania House Democratic Caucus Intervenors. I think you testified earlier, and please correct me if I'm wrong because it's been a long day, that you believe that all of these maps are within a certain, and these are my words, not your, range of reasonableness? Do you agree with me that they're pretty close together?

07:15:08 A. It's probably true, with some
07:15:11 exceptions. There are some few cases
07:15:11 in which some maps are farther from
07:15:13 the pack.
07:15:13 Q. So I think you talked about the
07:15:15 big six metrics.
07:15:15 Right?
07:15:18 A. Big six traditional principles.
07:15:20 Q. Yes, okay. The big six.
07:15:22 And all those, all the maps are
07:15:24 in a range that you would consider
07:15:28 reasonable for those big six
07:15:30 traditional principles?
07:15:32 A. With maybe a few exceptions
07:15:34 where maps are noticeably less compact
07:15:37 or have a few more splits.
07:15:40 Q. But you would agree with me
07:15:42 that compared to say the 2011 map,
07:15:44 which produced a 15 Republican
07:15:53 Congressional delegation and a three
07:15:59 Democratic delegation, none of the
07:16:00 maps that are proposed here are
07:16:01 lopsided like that?
07:16:03 A. I think it was 13-5 a lot of
07:16:03 the time.

07:16:03 Q. Oh, okay.
07:16:04 A. Just because let's be precise.
07:16:04 Q. I wish you were my political statistics professor because I can't do arithmetic in public.
07:16:07 A. One should not. Are you asking if any is as skewed as that?
07:16:12 Q. Yes.
07:16:14 A. I do find some of these maps to be extraordinarily skewed. It's hard to make an apples to apples comparison with a different number of districts. But I think that red and blue table we've come back to a few times does reflect extraordinary skew in a few of the maps.
07:16:17 Q. Okay.
07:16:17 And I'm just, I'm not trying to quarrel with you, I'm just wondering, because I do agree with you that these maps, with a few exceptions are within a range, a certain range of reasonableness. What factor do you then have to look at in order to sort of break the tie?
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07:16:52

Right? If everybody is in this range and we have to select, how do we do that?

A. Great.

So that's the approach I've tried to take here is to look at the fundamental principles, the ones that the Supreme Court describes as establishing a floor, and examine those and say if you want reasonable, then everything's on the table. If you want excellent, you might be able to narrow it a bit. Once you've passed that threshold, there are many other things you can consider. And I talked about a few, incumbency, and least change, but especially partisan fairness.

Q. And when you say partisan fairness, are you including in that term factors like potential voter dilution or dilution of votes, an individual vote's power?

A. Yes. My understanding as a redistricting expert of the way that

07:17:49 the Supreme Court decision wrote about
07:17:52 vote dilution is that they were
07:17:55 referring to, in part, partisan
07:17:57 dilution.
07:17:58 Q. Okay.
07:17:59 And for you, when you talk
07:18:04 about the partisan balance, is another
07:18:06 factor to consider potential
07:18:13 disenfranchisement of groups of voters
07:18:13 generally?
07:18:20 A. Absolutely.
07:18:21 Q. Now, we --- I think --- I
07:18:22 forget who asked you. Somebody
07:18:23 started talking to you and asking you
07:18:25 questions, and one of your responses
07:18:28 about the tilting of the typical way
07:18:31 that maps have been drawn in
07:18:33 Pennsylvania, and I'm conflating now
07:18:37 all this testimony, tilted towards
07:18:39 Republicans. Do you remember that or
07:18:41 it had typically tilted towards
07:18:43 Republicans?
07:18:44 A. Yeah. One --- it's probably
07:18:48 right. One reflection of that is I
07:18:51 reported these ensemble mean

07:18:52 statistics, which indicate that if you
07:18:55 draw blindly, much of the time, but
07:18:57 not all of the time, you'll get a map
07:18:59 with a heavy Republican structural
07:19:01 tilt.
07:19:01 Q. So if we look at, for example,
07:19:04 starting in 2011, the Democratic
07:19:08 registration advantage was 1.1 million
07:19:11 votes. And we had the lopsided result
07:19:15 either 15 to 3 or 13 to 5, like I
07:19:19 can't remember, but a more lopsided
07:19:22 result than we have currently. Do you
07:19:25 --- is there anything you attribute
07:19:27 that result to?
07:19:28 A. The relationship between
07:19:31 registration and the seats in the
07:19:33 delegations?
07:19:33 Q. The fact that the Democrats had
07:19:37 more than 1,000,000 voters registered
07:19:39 but had such a lower partisan
07:19:43 representation in Congress and from
07:19:45 the state?
07:19:48 A. I regard Congressional and
07:19:51 other districting plans as ways of
07:19:52 converting vote preferences into

07:19:54 representational outcomes. So it's a
07:19:55 property of the map, which I think is
07:19:56 what you're getting at.
07:19:58 Q. I was wondering. Okay. So in
07:20:01 2018, ---
07:20:01 A. Right.
07:20:02 Q. --- after the new map was put
07:20:04 into place, the Democratic advantage
07:20:07 had dropped to 840,000 votes by way of
07:20:09 registration. And the result was a
07:20:13 nine to nine, an even split in the
07:20:15 delegation at that time.
07:20:16 Is that accurate?
07:20:19 A. Well, let me --- I can't say
07:20:21 about the registration numbers, but I
07:20:24 believe you. But I will say that
07:20:26 Pennsylvania does have --- I think
07:20:27 it's an under appreciated fact about
07:20:33 Pennsylvania that there's quite a bit
07:20:33 of split ticket voting, in fact. I've
07:20:34 analyzed this in the past and so have
07:20:37 others in the room. And so I'm not
07:20:39 sure because I haven't analyzed how
07:20:41 well registration numbers track with
07:20:43 voting patterns. But I will agree

07:20:45 with you that they're often a useful
07:20:48 indicator.
07:20:49 Q. And certainly, were you in the
07:20:51 room when we discussed the 2016
07:20:52 election where the federal candidates
07:20:58 garnered more votes than the
07:20:58 state-wide Democractic candidates?
07:20:59 A. Yeah. Not only that, and I'll
07:21:01 be brief and say this in one sentence.
07:21:03 That even if you compare the Senate to
07:21:03 the Presidential race that year,
07:21:03 there's just a fascinatingly high
07:21:08 number of ticket splitters, even
07:21:08 though the top line results are
07:21:10 identical.
07:21:10 Q. So given that, now, because I
07:21:14 was up late last night, I'm was on the
07:21:17 department's website, and the voter
07:21:19 registration advantage as of Monday
07:21:21 was 591,000 Democrats more registered
07:21:25 Democrats than Republicans. We also
07:21:28 now will not have 18 seats, we'll have
07:21:31 17 seats. So as a result of that, and
07:21:35 based not only your big six, but also
07:21:37 the other factors we talked about, can

07:21:40 you give us an idea of what, in your
07:21:44 opinion, would seem to be a reasonable
07:21:46 or fair result for the partisan
07:21:49 breakdown of the Congressional
07:21:51 representatives?
07:21:52 A. It's a great question. And the
07:21:54 answer is that you can't do such a
07:21:55 thing. You can't take those numbers
07:21:57 and kind of project them forward to
07:22:04 like idealized representation because
07:22:04 it depends so much on the spatiality.
07:22:05 But I think that's what comes out in
07:22:08 these various reports and I think what
07:22:11 we've seen is that it's possible to
07:22:12 draw a fair plan by the likes of many
07:22:15 quantitative approaches.
07:22:17 Q. So is it fair to say that
07:22:19 regardless of what the difference is
07:22:23 between voter registration, whether
07:22:25 it's 1,000,000 votes for one party, or
07:22:27 900,000, or 800,000, that where you
07:22:31 draw the lines around those 1,000,000
07:22:34 or however many people, plays a
07:22:41 substantial role in determining of
07:22:42 what the outcome of the election will

07:22:44 be in those individual districts?
07:22:46 A. Absolutely fundamental role.
07:22:50 ATTORNEY SENOFF:
07:22:50 Thank you, Doctor. I don't have any further questions. Thank you, Your Honor.
07:22:52 JUDGE MCCULLOUGH:
07:22:53 Okay. Thank you, Counsel.
07:22:54 And then Senator Costa's Counsel, Mr. Attisano?
07:22:54 ---
07:22:54 CROSS EXAMINATION
07:23:31 ---
07:23:31 BY ATTORNEY ATTISANO:
07:23:35 Q. Hi, Professor. My name is Marco Attisano and I represent Senate Democratic Caucus.
07:23:38 A. Hi.
07:23:39 Q. You recognize that photo up there, the document, excuse me, that's page 11 from your first report.
07:23:47 Correct?
07:23:48 A. Yes.
07:23:48 Q. Okay.

07:23:49 Now, you answered some questions about
07:23:51 it earlier today?
07:23:51 Right?
07:23:53 A. Yes.
07:23:54 Q. And I have a clarifying
07:23:56 question. When you have the word
07:23:59 citizen plan there, are you referring
07:24:01 to the map that was drawn by former
07:24:05 Republican County Commissioner Amanda
07:24:08 Holt or are you referring to a ---
07:24:08 A. No.
07:24:10 Q. --- a different plan?
07:24:10 A. The Holt derived map is
07:24:14 HB-2146.
07:24:14 Q. Okay.
07:24:15 A. Citizens plan --- and I
07:24:16 apologize that so many maps have
07:24:19 similar names. But this is the name
07:24:22 given to the draw the lines
07:24:22 submission, ---
07:24:22 Q. Okay.
07:24:29 A. --- which was derived from a
07:24:29 mapping competition.
07:24:29 Q. Thank you for clarifying that.
07:24:33 Allegheny County has to be

split.

Correct?

A. Yes. It's one of three.

Q. Okay.

And some people asked you about splitting Pittsburgh?

Correct?

A. Yes.

Q. And whenever splits are to be made, it's appropriate and beneficial even to consider communities of interest when making splits.

Correct?

A. I think it's very important.

Q. Yes. And you've looked at the 2018 map.

Correct?

A. I have.

Q. And do you know off the top of your head how many splits of municipalities were made in Allegheny County in 2018 map?

A. I certainly don't have that number memorized.

Q. At one time --- so you don't

remember.

Right?

A. Right.

Q. If I showed you the 2018 map and pointed at some things on it, you think you might remember?

A. Well, we'd have to see the county subdivisions on the map. But if you had such a plan, we could count. But I'm also prepared to believe you.

Q. Do you have any reason to doubt there's two municipal splits in Allegheny County in the 2018 plan?

A. I have no first principles reason to doubt that.

Q. Any reason to doubt the splits are South Fayette and Penn Hills?

A. I'm willing to believe that.

Q. Is there any redistricting principle you're aware of that should influence splits of municipalities based on the size of municipalities?

A. Can I just try to rephrase that?

07:26:09 Q. Yes.
07:26:10 A. Are you asking if the size
07:26:11 influence is whether we should split a
07:26:14 municipality?
07:26:14 Q. Yes. Can you answer that?
07:26:15 A. There's no traditional
07:26:16 preference in that regard that I'm
07:26:18 aware of.
07:26:18 Q. Would considering the affect
07:26:22 --- let me rephrase that. Would vote
07:26:27 dilution be a consideration when
07:26:28 determining whether or not to split a
07:26:30 municipality if you must split a
07:26:33 municipality within a county split?
07:26:36 A. If you must split a
07:26:37 municipality, you should certainly
07:26:39 think about the prospects for vote
07:26:50 dissolution when you do so.
07:27:05 Q. I'm on page four of your reply
07:27:08 report.
07:27:08 A. Yes.
07:27:08 Q. And there's a top Section 4.2
07:27:10 and it has a table on there and then
07:27:14 underneath, there's 4.3 and it has
07:27:19 another table with color coding on it.

Correct?

A. Yes.

Q. And earlier we saw a nice graph with four quadrants in it?

A. Yes.

Q. Do either of those data sets correlate to that graph?

A. They do, thank you. This table is exactly what's illustrated in those kind of paint ball graphs.

Q. Okay.

A. It's the same data.

Q. So the data in this report is in those graphs. It's just represented by different visual.

Is that fair?

A. Yes, except that the visuals are only there for 3 of the 13 plans.

Q. Okay.

A. But it's the same data.

Q. Okay.

The upper left hand quadrant of the graph, tell me about that quadrant?

A. Yes, I will try to do so. So

07:28:09 that, since we're doing it from the
07:28:10 Republican point of view, that would
07:28:12 be where you have more Democratic
07:28:15 votes, but more Republican seats in
07:28:19 the upper left where the X is. Thank
07:28:20 you. The visual helps.
07:28:20 Q. Okay.
07:28:20 And that quadrant graph I'm
07:28:21 referring to is on page 14 of your
07:28:23 first report. And when there's a red
07:28:28 X in there, that's representing your
07:28:31 interpretation that something failed
07:28:32 this test?
07:28:32 A. Yes. Those quadrants,
07:28:38 especially when you get deep into
07:28:38 those quadrants, represent
07:28:54 anti-majoritarian outcomes.
07:28:54 Q. Okay.
07:28:55 And now, back to your reply
07:28:58 brief in section 4.2, which maps
07:29:06 failed those quadrants if you can
07:29:06 remember?
07:29:09 A. Well, so let me try to answer
07:29:10 that as well as I can and as
07:29:11 succinctly. When you're very close to

07:29:12 a 50/50 election, then it might be
07:29:15 reasonable if you have a .5001 to have
07:29:19 an odd number of seats, you know, one
07:29:21 more or one less.
07:29:21 Q. Uh-huh (yes).
07:29:22 A. So I think the more meaningful
07:29:25 failures are when you have a less
07:29:27 close election and still have a
07:29:29 majoritarian, anti-majoritarian
07:29:33 outcome.
07:29:34 Now, I believe we've seen
07:29:35 tables from other experts, perhaps
07:29:37 from Doctor Rodden if I remember
07:29:41 right, where those were color coded as
07:29:43 well. And I remember from that table,
07:29:45 which I have no reason to disbelieve,
07:29:51 there were two --- in that data set of
07:29:51 collections, two anti-majoritarian
07:29:54 outcomes in the Governor's plan
07:29:54 favoring Democrats and two favoring
07:29:58 Republicans. I believe that's what we
07:30:04 saw. We could check if we want to be
07:30:04 sure.
07:30:04 Q. And with respect to table
07:30:07 three, you agree that the Senate

07:30:09 Democratic Caucus plan, all of the
07:30:11 highlights there are red on this
07:30:13 metric.
07:30:14 Correct?
07:30:16 A. The Senate Democratic Caucus
07:30:22 plan?
07:30:25 Q. Yes, plan number one.
07:30:26 A. Oh, yes. Yes, I see.
07:30:26 Q. And if --- is that showing
07:30:27 Democratic advantage or Republican
07:30:29 advantage?
07:30:29 A. That's showing Republican
07:30:31 advantage.
07:30:31 Q. Okay.
07:30:36 And with respect to HB-2146,
07:30:39 that's the darkest red in each one.
07:30:41 Does that represent that that is
07:30:43 showing the most Republican advantage?
07:30:45 A. Yes. It's showing a strong
07:30:47 Republican advantage.
07:30:47 Q. Okay.
07:30:47 And when ---?
07:30:49 A. But again, ---
07:30:50 Q. Yes.
07:30:50 A. --- by the likes of these

07:30:52 metrics.
07:30:52 Q. Okay.
07:30:54 And it's possible to have a map
07:30:59 drawn randomly through an algorithm
07:31:05 and then select one of the maps that
07:31:07 is produced. That's possible?
07:31:09 Right?
07:31:09 A. Yes, and people have done so,
07:31:09 picked maps out of an algorithmic
07:31:10 output to consider for adoption.
07:31:18 Q. So even if somebody doesn't
07:31:20 draw a map intentionally for certain
07:31:22 outcomes, if they select a map, it
07:31:26 communicates certain trade-offs
07:31:28 between different factors we've been
07:31:29 discussing today.
07:31:30 Is that correct?
07:31:31 A. Yes. There are trade-offs
07:31:33 reflected in all of the maps.
07:31:34 Q. And the sixth traditional
07:31:46 redistricting factors, we make
07:31:47 trade-offs between them when
07:31:48 determining how far in one direction
07:31:49 we're going to go for one of those
07:31:53 factors and how far in one direction

we're going to go for another factor.
Correct?
A. We inevitably make trade-offs, yes.
Q. And the same trade-offs are made when optimizing a map for partisanship while still attempting to maintain a reasonableness related to the sixth traditional redistricting factors.
Correct?
A. It's certainly true that you could optimize a map for partisanship where what I think you mean by that is to get the most possible seats for one party or the other.
Right?
Q. Correct. Even while facially presenting reasonable redistricting principles that we've discussed?
A. Sure. You could search through a large collection of alternatives for something that had most of whatever you're looking for.
ATTORNEY GORDON:

07:32:35 Okay. Thank you. No further questions.

07:32:36 JUDGE MCCULLOUGH:

07:32:37 All right. Thank you, Counsel.

07:32:38 And we will turn now to Counsel for Governor, Mr. Wiygul, if you have redirect, I assume. Okay.

07:33:01 ATTORNEY WIYGUL:

07:33:01 Thank you, Your Honor.

07:33:01 ---

07:33:01 REDIRECT EXAMINATION

07:33:03 ---

07:33:03 BY ATTORNEY WIYGUL:

07:33:03 Q. Hello again, Professor Duchin. I know it's been a long day and I appreciate your time. Your work has already garnered a lot of interest, as you can see. I just want to address a few discreet points that were made during the Cross Examination. You may remember that Counsel for the Gressman Petitioners had a number of very energetic questions for your about particular data points that you had

07:33:23 calculated in your tables. Do you
07:33:25 recall that?
07:33:26 A. I do.
07:33:26 Q. And Counsel pointed out that
07:33:30 with respect to certain specific data
07:33:31 points, you concluded that those data
07:33:33 points showed that the Gressman plan
07:33:37 performed well.
07:33:37 Correct?
07:33:38 A. Yes.
07:33:38 Q. Okay.
07:33:38 Now, have you overlooked any of
07:33:40 that when you did your report?
07:33:43 A. No, I didn't. I tried very
07:33:45 hard in the report to just, like I
07:33:47 said, call balls and strikes and to
07:33:47 explain the reasoning that I was using
07:33:54 for making certain distinctions, for
07:33:57 looking at zones in some places, for
07:33:58 looking at small differences in other
07:33:59 places. I tried to give principle
07:34:01 reasons for that. What I wasn't able
07:34:03 to say before is that I think the
07:34:05 Gressman plan is an excellent plan. I
07:34:07 think it performs really well if all

07:34:10 of these measurable ways, but that if
07:34:14 you need to take the field and narrow
07:34:17 it in some of the specific ways I
07:34:19 described, that it doesn't end up in
07:34:23 those tiers.
07:34:24 Q. Not to quote the highlander,
07:34:27 but where in a situation where there
07:34:27 can only be one at the end of the day.
07:34:27 Right?
07:34:31 A. Well, or as in some states,
07:34:32 there can be many over the course of
07:34:33 ten years, but that's right. I think
07:34:35 our goal is to select for now one map.
07:34:37 Q. But you're not saying
07:34:39 everything else is terrible?
07:34:40 A. I'm expressly not. I think is
07:34:42 the last sentence; that I think the
07:34:45 Governor's plan is an excellent
07:34:48 choice, but not the only reasonable
07:34:49 choice.
07:34:50 Q. Similarly, I want to ask you
07:34:52 about some questions that Counsel for
07:34:57 Congressman Reschenthaler asked you.
07:34:57 There was a focus on the scores, and
07:34:58 maybe we can call this up, in table

one of your rebuttal report. And there were ten scores and I think came out that you said --- would it be easier to just --- yes, thank you. Ten scores. And I think, you know, you agreed with each other at the end that six of them went to the Reschenthaler plan and four of them went to the Governor.

Correct?

A. Yes.

Q. Okay.

Had you overlooked that when you formulated the conclusions in your rebuttal report?

A. No, that's fully accounted for in what I hope is fairly clearly --- I hope clearly presented reasoning.

Q. And one of the things that Counsel for Congressman Reschenthaler was asking you about was about splits and municipal splits. Do you remember that? And I think that was one where you conceded that the Reschenthaler plan was a bit better than the

Governor plan just on that metric.
Correct?
A. Yes. If you are singularly focused on splits, the Reschenthaler 1 and 2 plans have fewest.
Q. But when we need to formulate an overall conclusion or analysis, do we also need to look not just on whether one is better in a bimodal sense, but what the margin between them is?
A. Yeah. We should look at margins and we should think about trade-offs.
Q. And how would you generally characterize the margins between the various plans at issue here on say county splits?
A. Well, my view wasn't as that in a 17 district plan, if you're splitting fewer than 17 counties, you are giving high regard to that traditional principal.
Q. And just for a reference point, how many --- let's talk about

07:36:32 1 municipal splits, because we know, I
07:36:34 2 think we all know how many counties
07:36:36 3 there are in Pennsylvania.
07:36:37 4 A. Sixty-seven (67).
07:36:39 5 Q. Correct. How many --- and I
07:36:39 6 know this may depend on the specific
07:36:41 7 list, but how many municipalities?
07:36:43 8 A. It really does depends on how
07:36:45 9 you count, but around 2,500.
07:36:46 10 Q. So when the numbers in your
07:36:48 11 cart, we should be comparing to a
07:36:50 12 number around 2,500?
07:36:51 13 A. Yes. And so it's remarkable
07:36:53 14 that these split so few of these over
07:36:56 15 2,000 political subdivisions.
07:37:00 16 Q. I want to ask you about a few
07:37:03 17 questions that Counsel for the House
07:37:04 18 Republicans posed to you. There was a
07:37:06 19 question, I think it was a
07:37:08 20 hypothetical, along the lines of
07:37:10 21 asking do you think it would be okay
07:37:12 22 to ignore traditional redistricting
07:37:14 23 criteria to get the fairness, and I
07:37:16 24 think your answer was no.
07:37:18 25 Correct?

07:37:18 A. Yes.
07:37:18 Q. Is that what is going on with
07:37:20 the Governor's plan or any of the
07:37:22 other plans that you assessed as high
07:37:26 performing in your rebuttal report?
07:37:27 A. I don't think any of these can
07:37:30 be said to ignore the traditional
07:37:33 principles, but they do make
07:37:33 trade-offs and some manage those
07:37:36 trade-offs somewhat more effectively
07:37:37 than others.
07:37:37 Q. Counsel also asked you about
07:37:42 the methodology that you employed, and
07:37:43 I think with specific respect to the
07:37:43 ensemble analysis. And you said the
07:37:46 algorithm isn't in the report. To
07:37:48 your knowledge, do any of the reports
07:37:49 contain the algorithms used by the
07:37:51 analyst?
07:37:52 A. You know, from long ago, I have
07:37:54 seen expert reports with pseudo-code,
07:37:56 but I take that not to be a standard
07:37:59 thing to include in your report.
07:38:01 Q. Now, do you --- how familiar
07:38:03 --- let me put it this way. How

07:38:05 familiar are you with the algorithm
07:38:08 that you used?
07:38:09 A. I would be so delighted to be
07:38:11 asked in great detail about the
07:38:16 workings of these algorithms. It's
07:38:17 something that you can read about in
07:38:19 my published work. All of the code is
07:38:21 open source and available on Get HUB.
07:38:26 This is in contract to earlier
07:38:26 generations of redistricting
07:38:29 algorithms that were only turned over
07:38:29 in the discovery process, and so were
07:38:31 hard to audit. Our work is out there
07:38:32 in the public domain and I'm very
07:38:35 proud of it.
07:38:35 Q. And it's the methodology
07:38:40 developed, and peer---tested, and
07:38:42 reviewed in that domain that you
07:38:42 employ here.
07:38:42 Is that correct?
07:38:42 A. Yes. And as I said, the graph
07:38:46 algorithm that underlies it, it is the
07:38:47 one that Doctor Barber's drawing on as
07:38:51 well.
07:38:51 Q. And is it always the case ---

07:38:53 well, let me ask you, were you
07:38:55 involved in the development of that
07:38:57 algorithm personally?
07:38:59 A. Yes.
07:38:59 Q. Okay.
07:38:59 And is that true for all of the
07:39:01 experts that work in this field when
07:39:04 they compute their scores and they do
07:39:06 ensemble analyses, are they always ---
07:39:08 are they designing the algorithm? Are
07:39:09 they part of the creation of the
07:39:10 algorithm themselves or do they
07:39:11 sometimes just, you know, go to a
07:39:13 website, or pluck something off the
07:39:15 shelf that someone else has done?
07:39:19 A. No. I don't think it's the
07:39:20 case that the experts are always
07:39:22 involved in the creation of or even
07:39:24 especially knowledgeable about the
07:39:27 algorithms.
07:39:28 Q. And is that something that you
07:39:30 would urge the Court or others
07:39:30 evaluating expert work to take into
07:39:33 account when assessing different
07:39:34 expert reports?

07:39:35 A. I would hope it lends
07:39:37 additional credibility to my work.
07:39:39 Let me put it that way. That I have
07:39:44 put years of thought into not only
07:39:47 algorithms that sample effectively,
07:39:50 but how to use them responsibly.
07:39:55 Q. And how about the data, the
07:39:55 electoral data that you used in your
07:39:57 report? Is that something that you
07:39:58 got from a website? Is it something
07:40:01 that you or your team quality checked
07:40:03 yourselves or something in the middle?
07:40:05 A. We spent actually I think it's
07:40:08 fair to say years preparing the
07:40:10 Pennsylvania data, which is quite hard
07:40:13 to collect, align, and curate. And
07:40:19 whenever we used external sources, we
07:40:23 have quite rigorous quality assurance
07:40:25 checks. We use our own proration and
07:40:27 segregation tools. So I'm very
07:40:30 confident that our handling of the
07:40:32 electoral data is as good as possible
07:40:35 under the difficult conditions in
07:40:38 Pennsylvania.
07:40:39 Q. Can we put up Figure 8, page 19

07:40:43 of Professor Duchin's, I think it's
07:40:43 her rebuttal report. Yes. No, I'm
07:40:48 sorry. It's your opening report there
07:40:49 it is. We've seen this before and I
07:40:52 just, I want to go back to a set of
07:40:53 questions that was posed to you by
07:40:55 Counsel for the House Republicans.
07:40:57 Particular, maybe we could zoom in on
07:41:01 --- I would like to show the 0.00
07:41:03 line. And can you just remind us what
07:41:07 does that represent, 0.00?
07:41:10 A. So these metrics all have
07:41:15 different stories behind them,
07:41:16 different accounts of how they measure
07:41:17 fairness. But what they purport to
07:41:17 do, and I've chosen four that I think
07:41:21 are interesting and applicable for
07:41:23 this particular case at hand. What
07:41:24 they purport to do is measure kind of
07:41:26 evenhandedness. And so zero should
07:41:32 not be thought as like a Democratic,
07:41:36 you know, nirvana. On the contrary.
07:41:39 Zero is a point of balance and
07:41:41 fairness.
07:41:41 Q. And you described how you can

get to zero or close to zero with a map in Pennsylvania without sacrificing the traditional redistricting criteria.

Correct?

A. That's correct. And it's something in my published work I've sometimes called elasticity. Some states have vote patterns like in Massachusetts. They're just more rigid, and by following the rules, it's just hard to make certain outcomes appear. In Pennsylvania, by contrast, shows enough elasticity that you can get to partisan fairness while still upholding the traditional principles to an excellent degree.

Q. Now, would it be possible to go further and, you know, still upholding the traditional principles among the 100,000 maps, find ones that start to tilt away from level and towards a structural advantage for Democrats?

A. Absolutely. I think it's clear from the information here that the

Governor's plan, and frankly all of these plans, leave Democratic opportunity on the table. These are not Democratic maximization plans. And in particular, I think that's clear when you look part at the partisan metrics where the shading is meant to illustrate the intensity of the lean. You're not seeing blues across the board. And in the Governor's plan, you're really seeing numbers close to zero.

Q. And so do I understand correctly from your earlier testimony that when we get away from zero, as we get away from zero in either direction, we get into a situation where we're not adhering to your close votes, close seats principle?

A. Yes. And, you know, that brings another point to mind that I think is worth briefly --- since we're all tired, briefly clarifying. So in some cases, people have talked about the range of results and there's even

07:43:31 been some implicit criticism implying
07:43:33 that a larger range is worse. And I'd
07:43:36 just like to point out that in some
07:43:38 cases, that's really backwards.
07:43:41 Namely that you may call a map more
07:43:44 responsive exactly when it does
07:43:47 exhibit a larger range of outcomes.
07:43:49 And responsiveness is a word that I
07:43:50 think we all agree we're seeking.
07:43:52 So if you are always getting
07:43:53 the same seats outcome no matter how
07:43:58 people vote, you're not responsive to
07:43:58 the electorate. And so seeing
07:44:00 sumability for the outcome to vary
07:44:00 many would say is quite a positive
07:44:05 attribute of a plan.
07:44:05 Q. And when we're talking about
07:44:07 responsiveness is term you used, could
07:44:10 you sort of flush that out a little
07:44:12 bit? What does that mean in the
07:44:13 context of, you know, someone else, I
07:44:15 think Doctor Barber's report referred
07:44:16 to dynamism in elections over time.
07:44:16 What does that mean with respect to
07:44:23 changing preferences among the

07:44:24 majority of the electorate overtime?
07:44:27 A. As the sea level of voter
07:44:29 preferences rises and falls, you'd
07:44:30 like the representation to reflect
07:44:32 that. So you'd like the outcome to be
07:44:34 able to change along, to be literally
07:44:38 responsive in the sense of being
07:44:40 sensitive to the change in voter
07:44:44 preferences.
07:44:44 Q. And the maps that get away from
07:44:47 the zero mark, they don't, they are
07:44:50 not as responsive.
07:44:50 Is that correct?
07:44:51 A. It depends on the metric. And
07:44:53 so that's not a, kind of capital
07:44:56 letters all the time statement. But
07:44:58 when it comes to the plots that show
07:45:00 seats versus votes, it's generally
07:45:02 considered a healthy sign for a map if
07:45:06 you see some variation in the sea
07:45:10 level outcome.
07:45:10 Q. Is that one of the reasons why
07:45:12 you think it's important to look at
07:45:14 individual elections over time?
07:45:14 A. Oh, absolutely. That's another

07:45:19 reason why averaging really hides
07:45:20 something important. If you only look
07:45:22 at the aggregate, you're not seeing
07:45:23 the level of variability. Now, I
07:45:27 think reasonable people can disagree
07:45:30 on exactly how much, we've called this
07:45:31 a winners bonus. It's the exact same
07:45:33 thing that's been referred to as a
07:45:33 winners bonus. Exactly how much of a
07:45:36 swing you'd like in your map,
07:45:39 reasonable people can disagree. But I
07:45:41 would strongly dispute that simply
07:45:43 seeing a bigger range is a negative.
07:45:45 Q. So since you had I think five
07:45:50 or six other attorneys asking you
07:45:50 questions, I just want to give you an
07:45:51 opportunity was there anything that
07:45:56 was posed to you where you didn't have
07:45:56 a chance to give the answer that you'd
07:45:56 like to and you'd like to elaborate
07:45:56 here?
07:45:59 A. I think we've thoroughly
07:46:00 covered the terrain.
07:46:01 Q. I'm glad you agree. Thank you
07:46:01 very much.

07:46:01 ATTORNEY WIYGUL:

Thank you, Your Honor.

07:46:05 JUDGE MCCULLOUGH:

07:46:05 Thank you. All right. We're going to take a recess again and reconvene at 5:50. And we will do one --- we will have examination of one more expert witness this evening. That would be Republican Legislature's Representative Cutler's group, I think is next. But we will take a recess now and reconvene at 5:50.

07:46:31 COURT CRIER HOLLAND:

Commonwealth Court is now in recess.

(WHEREUPON, A BRIEF RECESS WAS TAKEN.)

08:15:06 COURT CRIER HOLLAND:

All rise. Commonwealth Court will now resume. Please be seated.

JUDGE MCCULLOUGH:

Okay. Thank you.

I hope you at least got

a comfort break. And we'll get you out of here tonight. I promise you don't have to sleep here unless something I don't know about.

Okay.

So we're going to do this next witness. We're going to have Direct and Cross on the Republican Legislature Representative Cutler, et. al group. So Counsel, who's --- okay, you're handling this and then ---.

ATTORNEY MORGAN:

Thank you, Your Honor. House Republican Intervenors call Doctor Michael Barber. And I have hard copies of both of his reports if Your Honor would like them.

JUDGE MCCULLOUGH:

That's okay. I have ---

ATTORNEY MORGAN:

Okay.

JUDGE MCCULLOUGH:

--- they're all over here.

COURT CRIER TURNER:

Please raise your right hand.

DOCTOR MICHAEL BARBER,

CALLED AS A WITNESS IN THE FOLLOWING PROCEEDINGS, HAVING FIRST BEEN DULY SWORN, TESTIFIED AND SAID AS FOLLOWS:

DIRECT EXAMINATION

BY ATTORNEY MORGAN:

Q. Good evening, Doctor Barber.

A. Hello.

Q. I want to start talking a little bit about the concept of political geography. What does it mean when we talk about the political geography of a state?

A. Typically when we talk about political geography, we're making reference to the spatial distribution of voters. So where do voters live throughout a state or some, you know, geographic location that we're

08:16:31 interested in studying, and how that
08:16:32 distribution might refer or be related
08:16:39 to the partisan tendances and
08:16:43 preferences of those voters.
08:16:43 Q. And can the political geography
08:16:44 of a state have an impact on the
08:16:46 partisan outcomes of elections?
08:16:46 A. Yes, they can.
08:16:48 Q. How so?
08:16:49 A. Well, it's especially the case
08:16:51 when we divide whatever location or
08:16:57 place we're talking about into
08:16:59 geographic districts. In this case,
08:17:01 we're talking about single member
08:17:03 districts. And so as you draw these
08:17:05 boundaries, it can really matter where
08:17:10 people live s and how those partisan
08:17:11 preferences are related to where they
08:17:13 live when those boundaries are imposed
08:17:15 onto the map that you're looking at.
08:17:17 Q. And have you examined
08:17:18 specifically the political geography
08:17:19 of Pennsylvania?
08:17:20 A. Yes.
08:17:21 Q. Doctor Barber, I want to refer

08:17:24 you to page eight of your report and
08:17:26 specifically figure one.
08:17:36 A. Okay.
08:17:37 Q. And what does this figure
08:17:38 reflect?
08:17:39 A. So this figure is simply a map
08:17:43 of the Commonwealth. And the colors
08:17:47 on the map represent the general
08:17:48 tendency of voters to support either
08:17:48 Democratic candidates or Republican
08:17:48 candidates.
08:17:55 And so you can see that the
08:17:56 partisan practices of voters in
08:17:58 Pennsylvania are not evenly
08:18:00 distributed --- distributed, excuse
08:18:02 me. You have really two areas in
08:18:06 which there's intense Democratic
08:18:09 support, and that's in the
08:18:10 Philadelphia area and in the
08:18:11 Pittsburgh area. You have other parts
08:18:13 of the state in which there are also
08:18:16 pockets of strong Democrat support in
08:18:20 the smaller and medium sized cities of
08:18:23 the state. But once you get into the
08:18:25 suburban area and the rural areas of

08:18:30 the state, you tend to see strong
08:18:31 support for Republican candidates and
08:18:31 that's reflected by the large spots of
08:18:33 red throughout the state.
08:18:41 Q. And does this impact the
08:18:42 Democratic party from being able to
08:18:42 translate their votes into seats?
08:18:44 A. It certainly has an impact,
08:18:46 yes.
08:18:46 Q. And how does it have an impact?
08:18:49 A. Well, it the way that it has an
08:18:51 impact, and we've heard others testify
08:18:52 to this as well, is that because we
08:18:55 use single member districts in drawing
08:19:00 in Congressional elections, and we
08:19:02 have these non-partisan registering
08:19:05 criteria as to how those districts
08:19:08 should be drawn, when those rules are
08:19:11 followed or when those boundaries are
08:19:13 drawn using those criteria, what you
08:19:16 end up with is you end up with some
08:19:18 districts, especially in as I said the
08:19:20 Philadelphia and Pittsburgh area that
08:19:21 are going to have extremely high
08:19:24 support for Democratic candidates. So

08:19:27 if you draw boundaries that have equal
08:19:28 population, that are contiguous and
08:19:31 compact, that don't extend out beyond
08:19:34 county boundaries, you're going to get
08:19:36 districts that have really, really
08:19:38 large majorities, in some cases
08:19:40 approaching, you know, 80, 90 percent
08:19:44 support for Democratic candidates.
08:19:46 Q. And can this disadvantage we'll
08:19:49 call it, can it be overcome?
08:19:49 A. Well, yes. You could certainly
08:19:49 overcome it if you ignored some of
08:19:54 those criteria and drew districts that
08:19:55 kind of started in the center of the
08:20:02 city and then moved outwards into the
08:20:04 suburban and rural parts of the state.
08:20:07 It can be overcome by electing members
08:20:08 of Congress using an alternative
08:20:11 system, not using single member
08:20:11 districts as well. But yes, there are
08:20:13 obviously ways that you could account
08:20:16 for this or adjust for this.
08:20:17 Q. And is one of those ways that
08:20:19 you have to specifically account for
08:20:21 this and consider that affect when

08:20:24 you're drawing District lines?
08:20:26 A. Well, you --- I mean, anyone
08:20:28 who draws District boundaries is going
08:20:30 to have to confront this, you know,
08:20:33 confront the geography of the state.
08:20:36 That's certainly the case no matter,
08:20:37 you know, who's drawing boundaries.
08:20:39 Q. In your opinion, is it
08:20:40 appropriate to draw lines to correct
08:20:42 for the spatial position of voters in
08:20:46 the State that may result in them
08:20:50 obtaining less seats then their
08:20:53 statewide vote chair?
08:20:55 A. Well, I think that that's
08:20:55 misguided --- a misguided approach for
08:20:56 two reasons. One is we don't have any
08:20:58 assurances or guarantees that that
08:21:00 distribution will maintain over the
08:21:03 next decade. And so, you know, we
08:21:05 might be addressing kind of fighting
08:21:06 the last war. We might be addressing
08:21:06 a problem today that the problem might
08:21:09 look very different a few years from
08:21:11 now or, you know, may not look the
08:21:14 same as it was a few years ago.

Beyond that it, you know, will often require the trading off some of these other criteria that we've discussed as the kind of typical or traditional criteria of redistricting.

Q. Okay.

Doctor Barber shifting gears a little bit. Did you conduct a simulated districting analysis for Pennsylvania's Congressional map?

A. I did, yes.

Q. And do you describe that methodology in your report?

A. I do, yes.

Q. And as I understand, you did not develop the algorithm that you used for this methodology.

Is that correct?

A. That's correct. The algorithm was developed by a professor of political science at Harvard University.

Q. And do you have to have developed the algorithm to understand how to use it?

08:21:59 A. No.
08:22:04 Q. Do you explain your methodology
08:22:05 in your report?
08:22:05 A. Yes.
08:22:07 Q. Now, Doctor Duchin likewise
08:22:10 created a, what she calls an ensemble
08:22:12 of maps.
08:22:13 Is that right?
08:22:14 A. That's correct.
08:22:14 Q. Okay.
08:22:15 And does she provide any detail
08:22:18 in her report about how she went about
08:22:20 creating that ensemble of maps?
08:22:23 A. No.
08:22:23 Q. And how does that impact your
08:22:25 ability to verify the veracity of the
08:22:28 ensemble of maps that she draws?
08:22:31 A. I really can't assess it one
08:22:34 way or the other.
08:22:34 Q. Well, back to your simulated
08:22:37 maps, Doctor Barber. Can you briefly
08:22:40 describe how you created your computer
08:22:42 simulated plans?
08:22:43 A. Sure. So there's a number of
08:22:48 parameters that are given to the

08:22:50 computer before you ask it to draw
08:22:52 these districts. They are the typical
08:22:55 redistricting criteria. So equal
08:23:00 population, continuity, compactness,
08:23:04 minimal division of political sub
08:23:05 units. Those are the criteria that go
08:23:07 into the algorithm. And then the
08:23:09 algorithm uses those criteria as well
08:23:12 as the distribution of voters
08:23:14 throughout the state to draw a number
08:23:15 of different maps that meet those
08:23:19 criteria. And then at the end of
08:23:21 that, you're left with a large sample
08:23:24 of maps for the state.
08:23:26 Q. So you use just traditional
08:23:28 redistricting criteria?
08:23:32 A. That's correct, yes.
08:23:33 Q. Did you use any partisan data
08:23:36 in creating the simulated maps?
08:23:38 A. No. The simulations are
08:23:39 entirely unaware of partisan, anything
08:23:40 about partisanship.
08:23:41 Q. So is it fair to say they are
08:23:43 partisan blind?
08:23:44 A. Yes.

08:23:44 Q. Did you use any racial data in
08:23:46 creating your simulated maps?
08:23:48 A. So in the main stimulation that
08:23:50 I present, the model is also unaware
08:23:53 of any race, racial data. Later in
08:23:59 the report, I present a second set of
08:24:00 simulations that do contain
08:24:03 information on the race of voters.
08:24:05 And that's so that I can instruct the
08:24:07 model to generate plans that meet a
08:24:09 certain number of districts that have
08:24:10 a certain threshold of minority
08:24:12 population.
08:24:12 Q. And why did you do that second
08:24:14 simulation, Doctor Barber?
08:24:16 A. The reason for that is that
08:24:18 lots of the proposals or the plans
08:24:21 that we've been seeing discussed the
08:24:24 number of districts that meet certain
08:24:26 thresholds of minority population.
08:24:29 And so one reasonable question is to
08:24:33 wonder well, if you impose that
08:24:35 criteria, if you instruct or if you
08:24:36 have that constraint, would that cause
08:24:39 there to be possibly a shift in the

08:24:41 way a neutrally drawn map would look.
08:24:49 And so, that second set of simulations
08:24:50 allows us to evaluate that.
08:24:50 Q. What is the advantages of a
08:24:50 simulation analysis as compared to
08:24:52 some of the other partisan metrics
08:24:54 we've heard about today?
08:24:58 A. So the main benefit of using
08:24:59 this approach, and I should say this
08:25:01 approach has been used widely in the
08:25:05 redistricting litigation, is that it
08:25:08 allows for a comparison of a proposed
08:25:10 map to a set of alternatives maps that
08:25:13 we know with certainty the criteria
08:25:16 that are used to draw those
08:25:17 alternative maps. So that's one
08:25:19 really big advantage. It allows for a
08:25:21 comparison to what I would call like a
08:25:24 control group.
08:25:25 So when you run an experiment,
08:25:27 you want to compare to some sort of
08:25:29 control that you kind of know the
08:25:33 criteria used in generating that
08:25:34 control. The other advantage is that
08:25:36 it allows for an apples to apples

comparison because both the proposed map and the set of simulated maps, they all have to account for the geography of the state. And so, you'll often see arguments about well, this, you know, the geographic distribution of voters might have the following impact. The simulations allow you to take compare to a set of maps that also take into account or to have to deal with the geography of the state.

Q. Do the other are metrics we've heard about today, efficiency gap, mean median, do those take into account the political geography of the state?

A. The way I would say it is that they are subject to the political geography of the state. But they don't allow you any --- the value that you observe of say, you know, the efficiency gap, or the median mean, or any of those metrics, the value that you observe, you can't really say

well, how does that value compare or how much of that value is due to geography as opposed to other factors that may have contributed to how a map was drawn.

Q. Doctor Barber, to your knowledge, did the Court and the League of Women Voters case rely upon similar simulation methodologies that you are employing in this case?

A. Yes, that's correct.

Q. How many simulated maps or plans did you generate?

A. So I instructed the computer to generate 50,000 maps and each map contains 17 districts.

Q. And are those 50,000 maps a representative sample of all possible redistricting in Pennsylvania?

A. Yes.

Q. Now, Doctor Barber, after you completed your simulation analysis, did you then analyze that the partisan lien of the districts in the simulations?

A. I did, yes.
Q. And how did you go about doing that?
A. So I take the --- each district in each of the simulated maps, in each of the 50,000 maps, and I look at the statewide votes, statewide elections over the previous decade, so from 2012 through 2020. And I look at the number of votes cast in those districts in those elections for Democrats and for Republicans, and then simply look at the proportion of those votes that were cast for Democratic candidates.
Q. And what elections did you use?
A. So it's state-wide races from 2012 through 2020. So this would be President, U.S. Senate, Governor, and then those four I can't remember term that Counsel used earlier, but I believe it's auditor, Attorney General, now they're escaping me. Treasurer, and there's one I'm forgetting, but it's in there.

08:28:27 Q. And did you do an average of
08:28:29 these elections?
08:28:30 A. So I calculate the average of
08:28:35 the or the proportion I would say of
08:28:37 the votes cast for Democratic
08:28:39 candidates in those races and the
08:28:44 proportion of votes cast for
08:28:45 Republicans in those races, yes.
08:28:45 Q. And is that a common
08:28:46 methodology used in your field?
08:28:48 A. It's very common. The reason
08:28:50 for that is so this is a subject of
08:28:53 criticism that was offered at my ---
08:28:56 of my approach. But the criticism is
08:28:58 actually one of the advantages because
08:28:59 these races are, we're working of
08:29:03 these races as a proxy of how these
08:29:07 districts are going to perform. We're
08:29:08 not --- none of these districts, we're
08:29:10 not going to elect an attorney general
08:29:12 in these districts or, you know, an
08:29:14 auditor, or something like that. And
08:29:15 so these elections are subject to the
08:29:17 idiosyncrasies of the particular
08:29:23 offices, the particular, you know,

elections that are being conducted, the candidates, their characteristics, those sorts of things.

And we don't want that. We want a picture of how the race is going to perform on average. And so by taking more elections and putting them together, we wash out the impact of any one particular election, the kind of idiosyncrasies of that particular race.

Q. Doctor Barber, before we get to the partisan results of your simulations, did you first examine how HB-2146 complies with traditional redistricting criteria?

A. Yes.

Q. Okay.

Can you please turn to page 16 of your report and specifically Table 1?

A. Yes.

Q. And can you explain what Table 1 shows?

A. So Table 1 is simply a

comparison of HB-2146 and the results of the simulations on boundary splits and compactness. And so each column shows for each of those plans.

Q. And how does HB-2146 compare to the simulated plans on these criteria?

A. So it's a little above the median in terms of county split, but within the range of the simulations. In terms of the municipal splits, the simulations are instructed not to divide municipalities and the reason for that is the simulations also allow for one half of one percent population bound, I suppose. And so you can do that without splitting any municipalities. And others have offered a similar explanation that what you see then is you have to, you know, equal --- if you were to pick any of those plans and say well, let's run with this plan, you would have to equalize population, and that would then require the splitting of a few municipalities. And so the fact that

you see 16 divisions in the plan and you've got 17 districts, that suggests that we're not splitting municipalities because we're, you know, in reality really kind of just equalling out population through those divisions.

Q. And did you look at how HB-2146 compared on these metrics to the other maps that were submitted to the Court?

A. Yes.

Q. Can you please turn to page eight of your rebuttal report and specifically Table 1 on that page?

A. Yes.

Q. And can you describe just generally what this shows?

A. Sure. So this is a table that looks like a lot of the tables that we've been looking at today. So there's been a lot of discussion of boundary splits, of measures of compactness. I'll just note that there's two columns here that we haven't seen as much of, and one is a

comparison of how the different plans treat the City of Pittsburgh. And then the final column looks at the number of competitive districts that are generated by each of the plans.

Q. And why did you look at how the plans treat the City of Pittsburgh?

A. Well, I think Pittsburgh is an interesting example because it's a city that --- well, one, you know, it's a very large city. It's the second largest city in the state, but it's not large enough that it needs to be divided because of its population, unlike Philadelphia. And so I think that it's an area in which if a plan does split the City, it calls for additional inquiry as to why that might be the case. And so I think it's a value for us to look at that.

Q. And why do you think it calls for additional inquiry?

A. Well, it stands out as an example of a plan possibly violating the neutral redistricting criteria.

08:33:20 So it's, you know, it kind of, it
08:33:25 rises --- it raises your kind of
08:33:29 attention as to oh, well, what's going
08:33:30 on here. And so we can then look at
08:33:32 the plans and see well, what is going
08:33:33 on? Why is the City being divided?
08:33:36 Q. Doctor Barber, can you turn to
08:33:38 page ten of your rebuttal report and
08:33:40 look at both figure two and table two
08:33:42 on that page please?
08:33:44 A. Yes.
08:33:44 Q. And can you explain what you
08:33:48 were showing here on page ten of your
08:33:50 rebuttal report?
08:33:51 A. Sure. So the top figure is
08:33:55 simply a map that's illustrative of
08:34:00 how many of the plans divides the
08:34:00 City. So we could look at maps of all
08:34:03 the different plans, but this was
08:34:06 simply to illustrate what I mean by
08:34:07 how the City is divided. The table
08:34:10 below then shows how the population of
08:34:11 the City is allocated across the two
08:34:15 districts that are inside of the City
08:34:17 of Pittsburgh, because it could be

08:34:18 possible that a plan splits the City,
08:34:20 but it only splits, you know, it moves
08:34:22 like 10 or 15 voters out the City.
08:34:26 But that's generally not the
08:34:28 case. As you look down, as plans
08:34:30 divide the City, it tends to be kind
08:34:32 of equal or, you know, pretty close to
08:34:36 equal.
08:34:38 Q. And did you analyze what might
08:34:40 be the partisan impact of splitting
08:34:44 the City of Pittsburgh as opposed to
08:34:49 keeping it all in one congressional
08:34:51 district?
08:34:51 A. Yes. So if you recall the map
08:34:53 of the state that we looked at
08:34:54 earlier, you can see very easily that
08:34:56 Pittsburgh is extremely Democratic and
08:34:58 the areas around Pittsburgh, both
08:35:00 within Allegheny County, but also the
08:35:02 counties around Allegheny County, are
08:35:04 more Republican leaning. And so one
08:35:07 thing that a redistricting --- one
08:35:11 thing that a person might do is to
08:35:12 say, well, if we made a District
08:35:14 that's all Pittsburgh and some of

suburbs around it, that District is going to be extremely Democratic. But if we were to divide the City in half, we could make two Democratic districts that would be lean Democratic pretty safe still, but not overwhelmingly Democratic.

Q. Okay.

Doctor Barber, now turning to the partisan lean of HB-2146. And before we get there, first off, what is meant by partisan lean?

A. So when I say partisan lean, I simply mean the results of that index of statewide elections.

Q. And did you examine the partisan lean of specific districts in HB ---- 2146?

A. I produced the partisan lean of all of the districts of HB-2146.

Q. Can you actually turn back to your original report now and specifically on page 21 and look at Figure 2?

A. Yes.

08:36:11 Q. And what were you showing here
08:36:11 in figure two, Doctor Barber?
08:36:11 A. So figure two simply shows the
08:36:11 results of that calculation of the
08:36:11 partisan index. And so the districts
08:36:29 are ordered from the most Republican
08:36:30 leaning at the bottom, all the way up
08:36:32 to the most Democratic leaning at the
08:36:34 top. So the districts that ---
08:36:34 there's a vertical line placed at .5
08:36:36 for reference. The districts that are
08:36:40 to the left of that line would be
08:36:42 Republican leaning and the districts
08:36:43 that are to the right of that line
08:36:45 would be Democratic leaning. The
08:36:48 other thing that I'll note is there's
08:36:51 little bars, horizontal bars that
08:36:55 aren't coming across quite as well on
08:36:57 the projector, but around each of the
08:36:59 districts.
08:37:00 And those horizontal bars show
08:37:00 the full range of all of the elections
08:37:02 used in creating that index. And so
08:37:05 it's incorrect to claim that I don't
08:37:08 show the full range of elections

because that's exactly what those bars do.

Q. And based upon those bars, is any individual district in HB-2146 an outlier when compared to the simulations?

A. When compared to the --- oh, I'm sorry. The bars are in reference to the elections, not the simulations.

Q. Well, in comparison of them, are any of them an outlier or are they all within the same range?

A. Oh. They're all within the range of the simulations, yes.

Q. Now, does figure two reflect whether or not HB-2146 creates any competitive districts?

A. It does, yes. So you can look at the districts that are very close to that .5 vertical line. And so those are districts that have, you know, an index very close to 50 percent. Beyond that, you can see that there are many districts where that horizontal line crosses the

dashed vertical line. And so those are districts in which both parties have won majority of two party vote in some of those races that are considered.

Q. And how do you define a competitive district?

A. So the first definition I use in my report is if that horizontal line crosses .5. So have at least, have both parties won a majority of the vote in at least one of the elections that I consider over that 2012 to 2020 period. The second way that I look at it is how close is each of that points to that .5 line. And I define competitive as if it's within two percentage points of 50 percent.

Q. And Doctor Barber, did you examine the other plans that were submitted to the Court to determine if they likewise created any competitive districts under your definition?

A. Yes, I did.

08:38:58 Q. Can you please turn back to
08:39:02 page eight of your rebuttal report and
08:39:06 look back at Table 1?
08:39:08 A. Yes.
08:39:08 Q. And what does this reflect
08:39:09 about how the other plans do on
08:39:11 competitive districts?
08:39:12 A. So that final column in the
08:39:14 table simply shows the number of
08:39:16 competitive districts in each of the
08:39:18 plans using that measure of whether
08:39:20 the index is within two points of
08:39:24 50 percent.
08:39:25 Q. Okay.
08:39:29 So we just sort of talked about
08:39:30 the partisan lean of HB, the districts
08:39:33 in HB-2146. Did you also look at the
08:39:35 partisan lean of the 50,000 simulated
08:39:38 maps that you generated?
08:39:40 A. Yes. So in the exact same way
08:39:41 that I calculated the lean for these
08:39:45 districts in the proposed plans, I do
08:39:47 the same thing for the districts in
08:39:49 the simulations.
08:39:50 Q. So it's an apples to apples

simulation?
A. That's correct.
Q. Can you turn to page 23 of your report and look at Figure 3?
A. Yes.
Q. And what does this figure show?
A. So this figure reports the results of that calculation. So each plan is going to have a different number or could have a different number of Democratic leaning districts. And so this simply reports the distribution of those 50,000 plans in terms of the number of Democratic leaning districts that are generated by the simulations.
Q. And so based upon this, what does figure three tell us about the partisan fairness of HB-2146?
A. Well, what it shows is that it's well within the range of districts that are drawn using only the redistricting criteria that we talked about earlier. It's not the most common outcome. The most common

outcome is actually eight Democratic leaning districts. But there's, you know, nearly a third of the results generate nine Democratic leaning districts, which is HB-2146 does as well.

Q. So if I understand this Doctor Barber, then the HB-2146 has predicted the result in nine Democratic leaning seats, but the most common outcome in your 50,000 unbiased maps is only eight Democratic leaning seats?

A. That's correct.

Q. Now, did you also calculate partisan leaning scores for the other maps submitted to the Court?

A. I did, yes.

Q. Could you turn now back to your rebuttal report again to page 15 and please look at Table 3?

A. Yes.

Q. And could you describe what you're reporting in Table 3?

A. So Table 3 is simply reporting on the same calculation for each of

08:41:45 the proposed plans. And we see that,
08:41:48 you know, there's a narrow range.
08:41:50 Some plans generating nine, some plans
08:41:53 generating ten, and one plan
08:41:55 generating 11 Democratic leaning
08:41:59 districts.
08:41:59 Q. And I see that there, that the
08:42:01 House Democrats plan is predicted to
08:42:03 create 11 Democratic leaning
08:42:06 districts. Is that an outlier?
08:42:09 A. So there were no simulations
08:42:09 that yielded that result. So yes,
08:42:09 that would be an outlier.
08:42:16 Q. And which of the submitted
08:42:19 plans result in ten Democratic leaning
08:42:20 seats?
08:42:20 A. Well, we you look down at the
08:42:22 table and we can see that, you know,
08:42:23 there's one, two, three, four, five,
08:42:31 six, seven, eight of them in that
08:42:34 table that general ten Democratic
08:42:34 leaning districts. I think it's eight.
08:42:35 Q. Now, we've sort of been looking
08:42:38 at the plan as a whole and how many
08:42:39 total Democratic leaning and

Republican leaning seats are generated. But did you also look how each District in HB-2146 compares to the specific districts in the simulations?

A. Yes. So one of the advantages of the simulations is you can get this very high level aggregate picture that we've been discussing here. But you could also go and look district by district to see well, how does the plan perform at a District level. And that can often shed light on kind of what's going on under the hood so to speak.

Q. Can you look at figure 4 on page 26 of your report?

A. Yes.

Q. And can you describe what's going on in this figure?

A. Yes. So the figure is ordered kind of moving from top to bottom by the most Republican leaning district in the simulations going down to the most Democratic leaning district in

08:43:46 the simulations. And so what I do for
08:43:50 each of the 50,000 plans, I plot the
08:43:53 partisan index of each of the
08:43:55 districts from most Republican to most
08:43:57 Democratic. What that does is it
08:43:59 creates these kind of clouds you might
08:44:02 say of kind of a range of partisan
08:44:09 indices for each of the districts.
08:44:10 And so you can see that the plan, you
08:44:11 know, moving down the figure, each
08:44:15 district gets a little more Democratic
08:44:17 because that's, you know, that's the
08:44:18 way they've been ordered.
08:44:25 On top of that cloud of gray,
08:44:26 which is showing the simulations, the
08:44:26 black dots then plot the proposed
08:44:28 plan, the HB-2146 plan in terms of how
08:44:32 the most Republican to the most
08:44:34 Democratic district fits inside of
08:44:38 simulation results. And so what you
08:44:42 can see is if you look at that top
08:44:45 row, the most Republican leaning
08:44:50 district in the plan is more
08:44:51 Democratic than 64 percent of the most
08:44:55 Republican districts in the

simulations. And so --- and that makes sense because that black dot is kind of in the middle of that cloud of gray. And you can go district by district down and look at well, how does each district align with the district---specific results in the simulations.

Q. So now looking at this at a district specific level, what does this tell us about the partisan fairness of HB-2146?

A. So I think that it shows that in terms of comparing to the simulations, it, even at a district level, fits squarely inside of the range of simulations generated only using the traditional redistricting criteria.

Q. Now, did you do a similar district---specific analysis for each one of the plans submitted to the Court?

A. I did, yes.

Q. Can you please jump back now to

your rebuttal report to page 18 and look at Figure 5? And I think we see sort of a similar graph to what we were just looking at. But can you please describe again what we're looking at here in figure five?

A. Yes. So this presents two of those plans. The remaining plan, the remaining figures are in the appendix. And so on the left, we have the Governor's proposal and on the right we have the Gressman proposal. And as I said, you can find the other ones at the end of the report. And so what you can then, you can see again is a comparison of how does the proposed, these proposed plans perform in relation to the simulations at a district by district level. I've added these boxes to highlight the four districts that are most competitive because these are the districts where a shift in the partisanship of a District could really make a difference in terms of

who wins or by, you know, by what type of margin. And so that box is simply to highlight the middle part of the results.

Q. And what do you conclude by looking at those four competitive districts for both of these two maps?

A. So what we see is that in both cases, the proposed plans are at the most Democratic leaning edge of the simulations. So looking at the left at the Governor's proposal, we can start with district one. We can see that that, in that district it is more Democratic than 98 percent of the simulated districts. In District eight, we see that it's more Democratic than 99 percent of the simulations. In district seven, we see that it's more Democratic than all of or nearly all of the simulated districts. And then the same is true for district six.

We can --- you know, and the story is much the same looking at the

08:48:02 Gressman proposal. It's even more of
08:48:04 an outlier. It's more Democratic in
08:48:07 those competitive districts than all
08:48:11 but I think 17 of the 50,000 plans
08:48:13 generated.
08:48:16 Q. And I think you just answered
08:48:17 this already, but does that mean these
08:48:19 particular districts are outliers?
08:48:22 A. Yes.
08:48:23 Q. And I think you said earlier
08:48:27 you did conduct this analysis for the
08:48:29 rest of the plans submitted to the
08:48:31 Court as well.
08:48:32 Correct?
08:48:33 A. That's correct, yes.
08:48:34 Q. Can you flip to the next page
08:48:35 and look at Table 4?
08:48:37 A. Yes.
08:48:37 Q. And can you describe for the
08:48:38 Court what is represented in Table 4?
08:48:42 A. So Table 4 is simply a summary
08:48:47 of those four districts that we just
08:48:49 looked at for each of the plans. And
08:48:51 so I simply report the percentile. So
08:48:56 the relative position of each of the

08:48:57 1 districts across those plans. So the
08:48:59 2 first line is HB-2146 and so you can
08:49:04 3 see in the seventh most Democratic
08:49:07 4 district, it's more Democratic than 17
08:49:07 5 percent of the plans. In the eighth
08:49:07 6 most Democratic district, it's more
08:49:07 7 Democratic than 17 percent of the
08:49:13 8 plans. In the ninth most Democratic
08:49:16 9 district, it's more Democratic than
08:49:18 10 49 percent. And then finally, it's
08:49:20 11 more Democratic than 81 percent of the
08:49:24 12 simulated districts. And so this
08:49:26 13 table simply summarizes the results of
08:49:28 14 that comparison for each of the plans
08:49:30 15 in that are being considered.
08:49:33 16 Q. And looking at Table 4 on page
08:49:35 17 19, can you draw any conclusions about
08:49:39 18 at least in these four competitive
08:49:41 19 districts which plan appears to be the
08:49:44 20 least bias?
08:49:47 21 A. Well, I think HB-2146 is that
08:49:49 22 plan. Looking down the rows, you can
08:49:52 23 see that in many of the proposals,
08:49:54 24 they sit at the very edge of the
08:49:58 25 simulated results in terms of their

08:50:02 Democratic lean of those districts.
08:50:06 Q. And for the other plans that
08:50:07 result in these competitive districts
08:50:09 with percentiles along the mid to
08:50:11 upper '90s, what are the odds that
08:50:14 that would occur simply from just
08:50:18 following traditional redistricting
08:50:20 principles?
08:50:20 A. It's incredibly unlikely.
08:50:22 Q. When you say incredibly
08:50:24 unlikely, can you quantify what you
08:50:26 think that might mean?
08:50:27 A. I mean, you could do a very
08:50:28 formal mathematical approach, but you
08:50:30 know, it's one in a, less than one in
08:50:35 a million probability of that
08:50:37 occurring.
08:50:37 Q. And given the political
08:50:39 geography of the state we talked
08:50:41 about, what is this telling you,
08:50:43 Doctor Barber?
08:50:44 A. Well, that's the virtue of the
08:50:46 simulation methods is that they
08:50:50 account, they also account for the
08:50:50 political geography of the state. And

so what we see here is that we have a lot of plans that are working to in some way adjust or differ from what would result from a neutral drawing given the political geography of the state.

Q. Thank you, Doctor Barber. So shifting gears a little bit, did you also analyze the partisan fairness of HB-2146 under any other metrics?

A. Yes. I use a variety of different matrix?

Q. Which ones?

A. So the median mean, the efficiency gap, and then what's referred to as the expected seat share from a uniform swing analysis.

Q. And let's start with the mean-median. And look, I'm sure we've all heard enough about that metric today. But just for a quick refresher, can you briefly again remind the Court of what that metric is and how it's calculated?

A. Yes. So again, it's simply a

measure of how does the median district compare to the average district.

Q. And did you calculate the mean median for HB-2146?

A. Yes.

Q. Can you turn now to page 21 of your rebuttal report?

A. Yes.

Q. Okay.

And what does Table 5 on page 21 reflect?

A. So it reflects the calculation of these values for each of the plans, as well as reporting how those plans sit in relation to the same metric calculated for each of the 50,000 simulated plans.

Q. And what did you calculate as the mean median value for HB-2146?

A. Negative 0.015.

Q. And what does that number mean, Doctor Barber?

A. It simply means that the average district was about one and a

half percent more Democratic than the median district.

Q. And how does that compare to the other plans submitted to the Court?

A. It's within the range. You have plans that have higher scores or, I'm sorry, lower scores, more negative scores. You have plans that have less negative scores. There are some plans with positive scores, some with negative scores. It fits what we've been seeing a lot of today, which is a lot of kind of oh, these plans are kind of similar.

Q. And Doctor Barber, are you aware that other experts in this case have likewise calculated mean median values for HB-2146 in other plans submitted to the Court?

A. Yes.

Q. And are you aware that other experts have calculated a different mean median value for HB-2146?

A. Yes.

08:53:31 Q. Can you explain what might
08:53:32 account for that difference?
08:53:33 A. So it's simply a function of
08:53:35 each expert is using a slightly
08:53:37 different election or set of elections
08:53:40 to draw their comparisons.
08:53:41 Q. And if you use a different set
08:53:43 of elections, you're going to get a
08:53:45 different outcome?
08:53:46 A. Yes.
08:53:46 Q. And to your knowledge, did you
08:53:49 use the broadest spectrum of
08:53:52 elections?
08:53:54 A. I don't recall off the top of
08:53:56 my head what other experts used. But
08:53:58 I used the basically a decade's worth
08:54:02 of elections in my --- in all of my
08:54:05 results.
08:54:06 Q. Now, aside from comparing the
08:54:09 mean-median number for HB-2146 to the
08:54:12 rest of the submitted plans, did you
08:54:14 also compare how it, that metric looks
08:54:17 when you compare it to the simulated
08:54:19 plans?
08:54:20 A. Yes. So that's what that next

column reports where it's labeled percentile. So that 85 says HB-2146 had a median mean value that was more, that was higher, larger than 85 percent of the simulated plans. I should clarify. When I say larger, I mean less negative, closer to zero than the results of the simulations.

Q. Would it be fair to say less biased?

A. Yes. That's a better way of saying it.

Q. And can you turn to Figure 5 on page 29?

A. Of my original report?

Q. Yes. Sorry. Of your original report.

A. I'm sorry. I had the wrong report up.

Q. And what is reflected in Figure 5?

A. So Figure 5 simply shows the results of what we were just talking about. That histogram of gray is the distribution of median mean results

for the simulations. And the black line shows where the HB-2146 plans falls. And so it's reported there that it's in the 85th percentile.

Q. Okay.

Doctor Barber, you can go back to page 21 of your rebuttal report, please. And I think you mentioned that you also looked and calculated an efficiency gap for HB-2146?

Correct?

A. That's correct.

Q. And, again, just for brief refresher, what is an efficiency gap metric?

A. So at a very high level, the efficiency gap is simply a measure how do the votes cast translate into seats earned by a particular party.

Q. And what do you report as the efficiency gap for the house plan in table five?

A. HB-2146?

Q. Yes.

A. Okay.

It has a value of negative 0.025.

Q. And again, what does that value mean?

A. So it's basically again like a negative --- a negative number is indicating a bias in the direction of Republicans. A positive is indicating a bias in the direction of Democrats. And you know, negative 0.025 is simply saying that Republican, I'm sorry, Democratic votes are slightly less efficient at being translated into seats than are Republican votes.

Q. And again, did you also compare the efficiency gap scores to the other maps that were submitted to HB-2146?

A. Yes.

Q. And how does it compare?

A. Again, it's within the range. And so there are other plans that have the same score. There are other plans that have a positive score. So you can see those there. And then the House Democratic plan stands out as

08:57:27 having the largest score of the set.
08:57:33 Q. And again, are you aware that
08:57:34 other experts in this case have
08:57:36 calculated efficiency gap numbers for
08:57:38 HB-2146 that are different than what
08:57:41 you calculated?
08:57:42 A. Yes.
08:57:42 Q. And again, what accounts for
08:57:43 that difference?
08:57:44 A. So again, it's simply a
08:57:45 function of the particular elections
08:57:47 that are used to make that
08:57:52 calculation.
08:57:52 Q. Doctor Barber, what is a
08:57:57 uniform swing analysis?
08:57:59 A. A uniform swing analysis simply
08:58:02 says well, what would happen if we
08:58:03 shifted the results of a plan
08:58:06 uniformly by a particular amount. So
08:58:10 what if we made the plan more
08:58:12 Democratic by one percent, or what if
08:58:15 we made it less Democratic by one
08:58:17 percent. That's why it's called
08:58:21 uniform swing. What if we shifted it
08:58:23 up or down by a particular amount,

what would happen? You know, would the number of seats change, so on and so forth.

Q. And did you perform such a uniform swing analysis on HB-2146?

A. Yes. So I should offer a little more clarification on what's going on. So you don't simply pick a random number and shift a plan by that. Well, you kind of do, but you let the computer choose the random number and you do it a bunch of times. So I do this about 5,000 times and you basically say pick a random number to shift the plan up or down based on a normal distribution that has a spread that is roughly equal to the kind of variation we see in elections in Pennsylvania.

So the typical spread in these elections we're looking at is about three percentage points. And so I say computer, pick a number from a normal distribution and then add that or subtract that to the plan, and

08:59:32 calculate the number of Democratic
08:59:34 leaning seats after you add that
08:59:35 number. Do that 5,000 times and then
08:59:37 take the average. And so this shows
08:59:39 the expected seats that are generated
08:59:41 from that, from that process.
08:59:43 Q. So if I could try to recap.
08:59:45 You're starting with actual elections.
08:59:47 Correct?
08:59:48 A. That's correct, yes.
08:59:48 Q. And you're essentially
08:59:50 simulating what might happen if the
08:59:50 election was a little bit different.
08:59:55 A. That's right, because we know
08:59:57 that over the next ten years, we know
08:59:58 that, you know, there are going to be
08:59:59 some years that are good for
09:00:01 Democrats. There are going to be some
09:00:02 years that are good for Republicans.
09:00:02 We know that, you know, it's going to
09:00:04 be more likely that it's going to be a
09:00:06 small shift than a large shift. There
09:00:07 might be a big, you know, six point
09:00:10 swing at some point in the next ten
09:00:11 years. But that's going to be less

likely than a one point swing or something like that. And so that's what this is doing is saying kind of what do we expect the plan to do over in the future as we see kind of shifts in electoral tides going forward.

Q. And does table five also reflect the results of your uniform swing analysis for both HB-2146 and the other plans submitted to the Court?

A. Yes, that's a correct.

Q. And one clarifying question. For all three of these metrics, you're performing the same exact methodology, the same analysis, using the same sets of election data.

Correct?

A. Right. It's consistent across all the plans and across the simulations as well.

Q. So what do the results of your uniform swing analysis show about the partisan fairness of HB-2146 when compared to the other plans submitted

to the Court?

A. So again, looking down that column, you can see that there there's a variety of results. Some of the plans on average perform more favorably for Democrats. Some of the plans on average are going to perform more favorably for Republicans.

That next column again says well, where does that sit in relation to this distribution of the simulated maps. And so where does that expected value sit in terms of the distribution. And so that's what that percentile column shows as well.

Q. Now, Doctor Barber, we've talked about a lot of comparisons of HB-2146 to all the other plans submitted to the Court. You didn't analyze any of the plans that were proposed by the Democratic Caucus during the legislative process, did you?

A. No, I did not.

Q. And why not?

09:01:57 A. I'm not aware that there were
09:02:00 any.
09:02:02 Q. And Doctor Barber, I think we
09:02:04 talked at the beginning of your
09:02:06 testimony about the simulations, that
09:02:09 you did not factor race into the
09:02:12 simulations at all.
09:02:15 Correct?
09:02:15 A. That's correct. So all of the
09:02:16 results that we've been looking at,
09:02:17 the simulations are drawn without any
09:02:22 information about the distribution of
09:02:24 race.
09:02:25 Q. Now, did your failure to
09:02:27 consider race skew the partisan
09:02:27 outcomes of your simulations?
09:02:27 A. No, it did not. And that's the
09:02:29 reason that we have this additional
09:02:30 set of simulations to look at.
09:02:33 Q. Well, can you turn back to your
09:02:34 original report and look at Figure 8
09:02:39 on page 35, please?
09:02:41 A. Yes. I think it's page ---.
09:02:51 Q. And I think I misspoke. I
09:02:57 think it's Figure 8 on page 37.

09:02:57 A. Yes, I have it.
09:02:58 Q. And can you describe what is
09:02:59 being depicted in Figure 8?
09:03:01 A. Sure. So there's three
09:03:02 distributions here. The left
09:03:03 distribution is the one we've already
09:03:05 seen. So this is the 50,000
09:03:06 simulations that are drawn without any
09:03:10 information about partisanship or
09:03:14 race. The middle figure says well,
09:03:16 simply by virtue of the political
09:03:18 geography of the state, some of the
09:03:20 plans that are drawn even without
09:03:23 information about race are going to
09:03:25 generate a certain number of districts
09:03:27 that have these thresholds that we've
09:03:31 been --- some of the plans have been
09:03:32 discussing.
09:03:33 So that middle figure says
09:03:35 well, let's only consider the
09:03:36 simulations that contain at least one
09:03:39 majority black district and two
09:03:42 majority minority districts.
09:03:44 The third figure is the result
09:03:47 of a separate set of 5,000 simulated

maps that do have information about race and explicitly tell the model generate plans that contain three minority opportunity districts. And so, you can see that this allows us to kind of look at well, what happens when you do consider race in terms of the simulations. Focusing on the figure at the far right, we basically, we generally see what I would say a reduction in the variation. What you see is that nine Democratic leaning districts becomes the overwhelmingly most common outcome in the simulated plans. About 70 percent of the simulations generate nine Democratic leaning districts when you instruct the model to take race into account.

Q. And again, using your part index, how many Democratic leaning seats do you predict HB-2146 to yield?

A. So that black line indicates the HB-2146 proposal at nine districts.

Q. So it would be consistent with

09:04:55 the most outcome in the simulation?
09:04:58 A. That's correct.
09:05:01 Q. Doctor Barber, just a few final
09:05:03 questions. In your opinion, does
09:05:05 HB-2146 adhere to traditional
09:05:07 redistricting criteria of equal
09:05:10 population, contiguity, compactness,
09:05:10 and minimizing political subdivision
09:05:10 splits?
09:05:18 A. Yes.
09:05:18 Q. And from your overall analysis,
09:05:20 can you draw some conclusions about
09:05:25 the partisan fairness of HB-2146?
09:05:26 A. Well, I think as we've looked
09:05:26 across a variety of these metrics,
09:05:30 that when we draw comparisons to a set
09:05:32 of districts that are drawn only using
09:05:34 the non-partisan criteria, we know
09:05:37 have not considered partisanship, the
09:05:42 HB-2146 sits squarely in that
09:05:46 distribution.
09:05:48 Q. In your opinion, is HB-2146 in
09:05:51 any way a gerrymander that favors
09:05:54 Republican voters over Democratic
09:05:55 voters?

09:05:57 A. No.
09:05:57 Q. Are you opining that HB-2146 is
09:05:58 the best plan?
09:05:59 A. I think that that is not for me
09:06:01 to decide. I think that is the
09:06:05 unenviable task of this Court.
09:06:05 ATTORNEY MORGAN:
09:06:07 I understand. Thank
09:06:08 you, Doctor Barber. No further
09:06:11 questions, Your Honor.
09:06:11 JUDGE MCCULLOUGH:
09:06:11 Okay. Thank you.
09:06:12 So we will proceed with
09:06:13 Cross Examination from Petitioners
09:06:13 Carter.

09:06:13 CROSS EXAMINATION

09:07:01 BY ATTORNEY GORDON:
09:07:01 Q. Good evening, Doctor Barber.
09:07:01 A. Hello.
09:07:05 Q. My name is Matthew Gordon. I
09:07:05 represent the Carter Petitioners in
09:07:06 this case. A few initial questions
09:07:08 for you. Are all the analyses that

you performed in connection with your work on this case identified and described in your two reports that you submitted?

A. Yes.

Q. And those reports accurately describe the methodology that you deployed here?

A. Yes.

Q. And if I understand correctly, the methodology is a simulated redistricting analysis?

A. Yes, that's correct.

Q. And this is a different --- I'm sorry. You testified that this was an analysis that was performed by experts in the LWV case, a similar type of analysis?

A. It's similar. The particular algorithms are different. Every expert kind of has their own particular method, but the overall process is very similar.

Q. Sure. So you use a different algorithm than the experts in the LWV

09:08:05 case.
09:08:05 Correct?
09:08:05 A. That's correct, yes.
09:08:06 Q. Have you used that algorithm
09:08:08 before?
09:08:09 A. I have, yes.
09:08:10 Q. How many times?
09:08:11 A. I have used it in analyzing the
09:08:13 Pennsylvania state legislative plan
09:08:16 for the House of Representatives, as
09:08:17 well as in the North Carolina State
09:08:22 House and State Senate.
09:08:22 Q. And is the North Carolina case
09:08:24 the one that you testified at trial in
09:08:26 on January 5th?
09:08:30 A. Yes, that's correct.
09:08:30 Q. And you testified at trial
09:08:31 there, I assume accurately, that your
09:08:34 academic work has not focused on
09:08:36 redistricting.
09:08:38 Correct?
09:08:38 A. So I think I --- yes. I think
09:08:39 I said in the testimony that I have
09:08:45 not published on these particular
09:08:46 topics, but that I teach about them in

my courses, and that I have extensive amount of work in litigation on these issues.

Q. But in terms of published academic work, you haven't published in the area of redistricting.

Correct?

A. That's correct.

Q. And you haven't published in the area of partisan influence in the redistricting process, have you?

A. That's correct.

Q. None of it involves simulated redistricting analyses.

Correct?

A. That's correct. As I think I said in North Carolina, I have published work that uses algorithms that are very similar in the, you know, kind of the underlying method that's being used. But with respect to the particulars of the redistricting algorithm, that's correct.

Q. And you testified in North

09:09:37 Carolina just about three weeks ago
09:09:38 that before that case you had never
09:09:40 used that algorithm before.
09:09:42 Correct?
09:09:43 A. Before that?
09:09:45 Q. Before the North Carolina case?
09:09:48 A. Before North Carolina. That's
09:09:49 --- that's correct. It --- the
09:09:51 Pennsylvania and North Carolina kind
09:09:57 of overlap so I don't want to --- I
09:09:59 don't have my --- you know, the exact
09:09:59 dates but.
09:10:00 Q. Sure. I'm just asking about
09:10:02 your testimony in North Carolina?
09:10:06 A. Broadly? Yes, that's what I
09:10:06 said in North Carolina. Yes.
09:10:06 Q. And that was accurate?
09:10:08 A. Yes.
09:10:08 Q. And you also testified that
09:10:08 before the North Carolina case, you
09:10:09 had never used any algorithm to
09:10:12 generate simulated district maps.
09:10:17 Correct?
09:10:17 A. That's correct.
09:10:18 Q. You have testified in court

before though?

A. I have, yes.

Q. And on multiple occasions, the Court has concluded or found that your testimony should be given little weight or no credit.

Correct?

A. I believe those are the words of the Judge. I disagree with the assessment, but those are the judge's words.

Q. I'm sure you do. I'm just asking if that's --- if that, if I accurately described what the courts have said about your testimony on multiple occasions?

A. That's correct.

Q. In the Common Cause versus Lewis case in North Carolina, do you recall that case?

A. I do, yes.

Q. And for the Court's benefit, this is 2019 Westlaw 4569584. In that case, the Court went through a number of what are called shortcomings in

09:11:09 your analysis and said in light of the
09:11:11 above shortcomings in Doctor Barber's
09:11:11 analysis, the Court gives little
09:11:13 weight to his testimony.
09:11:17 Do you recall that?
09:11:18 A. I do. It's --- it's I think
09:11:18 noteworthy that one of the ---.
09:11:18 Q. I just asked if you recalled
09:11:20 that.
09:11:20 A. I do recall that, yes.
09:11:21 Q. You answered the question,
09:11:22 thank you. In Jones v. DeSantis, do
09:11:26 you recall testifying in that case?
09:11:28 A. I do, yes.
09:11:29 Q. And for the Court's benefit,
09:11:31 that was reported at 462 F. Supp. 3d
09:11:36 1196. Do you recall that the Court
09:11:40 there in discussing your testimony
09:11:42 said I do not credit the testimony?
09:11:44 Do you recall that?
09:11:45 A. I believe that, yes, those are
09:11:48 the judge's words.
09:11:48 Q. And do you recall that the
09:11:51 Court said one in search of a textbook
09:11:53 dismantling of unfounded expert

testimony, would look long and hard to find a better example than the cross examination of you.

Do you recall that?

A. I, yes. I do.

Q. Let's talk a little bit about the methodology that you deployed here. On page 11 of your initial report, you said that you conducted a simulated districting analyses to, quote, gauge the degree to which the HB-2146 plan is a partisan gerrymandered.

Do you agree that that's the question you set out to answer? See at the top of page 11 of your report, first sentence?

A. I see that, yes.

Q. And that's the question that you set out to answer.

Correct?

A. It's certainly not the only question that I set out to answer, but it's one of the objectives of the report.

09:13:04 Q. Now in comparing --- in
09:13:05 conducting a simulated analysis as you
09:13:07 did here, as you said you have to have
09:13:09 a control set.
09:13:10 Correct?
09:13:12 A. That's correct.
09:13:12 Q. And your control set here are
09:13:16 the 50,000 simulated maps you
09:13:18 generated.
09:13:18 Correct?
09:13:19 A. That's correct, yes.
09:13:20 Q. And for, to have a valid
09:13:22 comparison against the control set you
09:13:25 need to be able to do an apples to
09:13:27 apples comparison.
09:13:28 Correct?
09:13:29 A. Correct.
09:13:29 Q. So the control set needs to be
09:13:33 --- can creating the same types of
09:13:37 maps or created under the same
09:13:38 conditions as the set, the plan that
09:13:39 you want to compare against the
09:13:41 control set.
09:13:42 Correct?
09:13:42 A. Yes, that's correct.

09:13:43 Q. But that's not what you did
09:13:48 here. They were not the same
09:13:49 conditions, were they?
09:13:51 A. I'm not sure exactly what you
09:13:52 mean.
09:13:52 Q. Okay.
09:13:53 Let's talk about that. You --- the
09:13:56 simulated maps you created were
09:13:59 allowed to vary from equal population?
09:14:00 Correct?
09:14:02 A. Yes, that's correct. I ---.
09:14:03 Q. By up to 3,800 people per map.
09:14:05 Correct?
09:14:07 A. Yes. I noted that it's a one
09:14:09 half of one percent variation.
09:14:11 Q. Okay.
09:14:11 But you would agree with me that a
09:14:13 deviation of 3,800 people is not equal
09:14:21 population?
09:14:21 A. Well yes, of course. That's
09:14:22 ---.
09:14:22 Q. So the maps that you created,
09:14:25 some of them, many of them would have
09:14:27 had deviations that rendered them not
09:14:31 of equal population.

09:14:32 Correct?
09:14:33 A. I note that in my report that
09:14:35 ---.
09:14:35 Q. It's a yes or no.
09:14:38 Is that correct?
09:14:41 A. That is correct, yes.
09:14:42 Q. That is correct. And so those
09:14:42 maps, many of those maps would have
09:14:45 been unconstitutional under your
09:14:50 understanding of --- of the
09:14:50 requirement for equal --- equal
09:14:52 population.
09:14:52 Would you agree with that?
09:14:53 A. I --- I think I explained that,
09:14:54 how that is the case in my report and
09:14:56 the reasons for doing that and.
09:14:57 Q. Sure. So just, I'm sorry. I'm
09:14:59 just limited on time. You would agree
09:15:01 with me that many of the maps that
09:15:04 were created in your simulation would
09:15:06 be unconstitutional because they would
09:15:08 violate equal population?
09:15:10 A. Yes. They're not intended to,
09:15:12 there's --- no particular map that's
09:15:14 intended to be a proposed map that the

Court should enact.
Q. Sure. And none of those simulated maps have had that variation would not have been similar to HB-2146 that did not have such a --- such a variation.
Correct?
A. Similar in population?
Q. Correct. They're different.
A. That's correct.
Q. Now you also said that the simulation maps did not split any precincts or municipalities except Philadelphia.
Correct?
A. That's correct.
Q. And you made a conscious decision to choose to not split any municipalities except Philadelphia and give up equal population?
Correct?
A. That's correct. The algorithm works much better when that decision is --- is made.
Q. So --- and in fact HB-2146 did

09:16:04 split municipalities.
09:16:06 Correct?
09:16:07 A. Yes.
09:16:07 Q. As did every other map that's
09:16:11 up for consideration here?
09:16:12 A. Yes, that's --- that's correct.
09:16:12 Q. So fair to say none of your
09:16:14 50,000 maps are going to be comparable
09:16:17 to any of the maps up for
09:16:19 consideration here including HB-2146
09:16:22 on the municipalities split metric?
09:16:25 A. So I note that in the report
09:16:28 that ---.
09:16:28 Q. So the answer's yes?
09:16:32 A. As you need to adjust
09:16:34 population, you would then have to
09:16:34 split a certain number of
09:16:37 municipalities.
09:16:37 Q. You talked on Direct
09:16:39 Examination about outliers.
09:16:40 Do you recall that?
09:16:41 A. Yes.
09:16:41 Q. But in your report, and this is
09:16:42 at page 16 of your rebuttal report,
09:16:45 you said didn't you that there is no

universally agreed definition of statistical outliers in this context. Correct?

A. That's correct. There's no bright.

Q. So when you say outliers, you're not talking about outliers from a statistical prospective. Correct?

A. One could apply a statistics approach and --- and look at a quote unquote a statistically significant outlier. And the ---.

Q. And I'm not --- I'm sorry. I'm not asking if anybody else could do that. I'm asking if you ---.

ATTORNEY MORGAN:

Your Honor, he needs to let the witness speak.

JUDGE MCCULLOUGH:

Yeah. Excuse me, counsel.

ATTORNEY GORDON:

Sure.

JUDGE MCCULLOUGH:

There was an objection. He --- he was trying to answer the question that you asked. So I think you can, just let him answer that question.

ATTORNEY GORDON:

Sure.

JUDGE MCCULLOUGH:

If you think he's going onto another topic, go ahead and move to your next question.

ATTORNEY GORDON:

Sure.

JUDGE MCCULLOUGH:

Just I --- I think he was ---.

BY ATTORNEY GORDON:

Q. Go ahead.

A. So you could've --- you could use a statistically significant, a measure of statistical significance. If you were to use that, then by that same definitions those would be outliers. But it's not universally agreed upon that that particular

09:17:51 method is appropriate in analyzing
09:17:53 these plans.
09:17:54 Q. And so, I wasn't asking if you
09:17:56 could do that. I was asking if --- if
09:17:57 you were, when you use the word
09:17:59 outlier, you're not using that in a
09:18:06 statistically significant context.
09:18:06 Correct?
09:18:07 A. I am not using it in the
09:18:07 context of what scientists would refer
09:18:09 to as statistically significant.
09:18:10 That's a separate topic that applies
09:18:16 in a different area. It does not
09:18:19 apply to this particular analysis.
09:18:20 Q. So your use of the term outlier
09:18:23 is your subjective determination that
09:18:24 something is an outlier rather than an
09:18:25 objective determination based on a
09:18:27 statistical analysis.
09:18:29 Correct?
09:18:29 A. It's subjective. However, I
09:18:34 pointed out that it's you know, 98,
09:18:37 99, 100 percent of plans being less
09:18:38 Democratic. I don't imagine that by
09:18:42 any measure that someone would say

09:18:45 that that was not an outlier.
09:18:46 Q. If we go to the mean-median
09:18:49 analysis that you discussed at page 21
09:18:51 of your rebuttal. This is Table 5.
09:19:02 Do you recall testifying about this on
09:19:04 Direct Examination, Doctor barber?
09:19:06 A. Yes.
09:19:06 Q. And do you recall that, if I
09:19:07 understand we're just going to look at
09:19:09 the mean-median value in the first
09:19:11 column. And I believe you testified
09:19:13 that closer to zero indicates less
09:19:16 bias.
09:19:16 Correct?
09:19:17 A. Yes, that's correct.
09:19:18 Q. Further from zero indicates
09:19:20 more bias then.
09:19:21 Correct?
09:19:22 A. Yes, that's correct.
09:19:23 Q. And here negative numbers
09:19:24 further from zero would be more biased
09:19:26 in favor of Republicans and positive
09:19:29 numbers would be more bias in favor of
09:19:31 Democrats.
09:19:32 Correct?

09:19:33 A. That's correct.
09:19:33 Q. And counsel asked you how did HB-2146 perform on this mean-median analysis.
09:19:35 Do you recall that?
09:19:38 A. I do, yes.
09:19:39 Q. And I believe you said well, it was in the mix. There were, and I'm paraphrasing, but you said that there were some that were higher and some that were lower than HB-2146.
09:19:40 Correct?
09:19:42 A. Yes.
09:19:43 Q. In fact, there are only two that are lower than HB-2146.
09:19:45 Correct?
09:19:47 A. That is correct.
09:19:49 Q. And those are the two Reschenthaler plans.
09:19:51 Do you agree with me?
09:19:51 A. Yes.
09:19:52 Q. Those are the only ones that are further from zero than HB-2146?
09:19:53 A. Yes. I think I said some, and two is some.
09:19:57
09:19:59
09:20:00
09:20:01
09:20:03
09:20:04
09:20:04
09:20:07
09:20:12
09:20:14

09:20:15 Q. Sure. And we're just
09:20:16 identifying which ones they were?
09:20:19 A. Okay.
09:20:20 Q. So every other plan other than
09:20:21 the Reschenthaler maps is closer to
09:20:23 zero than HB-2146.
09:20:26 Correct?
09:20:27 A. That's correct.
09:20:27 Q. Under that metric, every other
09:20:29 plan, other than the Reschenthaler
09:20:32 maps, is less biased than HB-2146.
09:20:35 Under your definition of --- of how
09:20:38 this works.
09:20:41 Correct?
09:20:41 A. Of the four --- I think there's
09:20:44 14 up there. But with that second
09:20:46 column also then says ---.
09:20:47 Q. I'm not asking about the second
09:20:49 column. I'm just asking about the
09:20:50 first column. On the mean-median
09:20:55 value that you did here, correct me if
09:20:57 I'm wrong, but every map other than
09:20:59 the two Reschenthaler maps is closer
09:21:02 to zero and less biased than HB-2146.
09:21:07 Correct?

09:21:07 A. I'm sorry, I think the
09:21:08 confusion is when you say every other
09:21:10 map. Because that next column says
09:21:12 well we also need to consider the
09:21:13 simulated maps, so ---.
09:21:14 Q. Sorry. Let me --- let me
09:21:16 correct my, that's --- that's fair.
09:21:17 Every other map that is presented in
09:21:19 this litigation, not considering the
09:21:21 simulated maps that were created with
09:21:27 unequal population and no municipality
09:21:29 splits.
09:21:30 Are we on the same page?
09:21:31 A. Yes.
09:21:31 Q. Okay.
09:21:32 Every other map that was
09:21:32 submitted in this litigation, other
09:21:35 than the two Reschenthaler maps under
09:21:37 your metric is less biased than
09:21:39 HB-2146.
09:21:41 Correct?
09:21:42 A. That's correct.
09:21:44 ATTORNEY GORDON:
09:21:44 No further questions.
09:21:45 Thank you.

JUDGE MCCULLOUGH:

Okay. Thank you, Counsel.

And now counsel for Mr. Gressman. So much to do.

ATTORNEY HIRSCH:

Sorry to bring so much stuff up here with me.

CROSS EXAMINATION

BY ATTORNEY HIRSCH:

Q. Good evening, Doctor Barber.

A. Hello.

ATTORNEY HIRSCH:

And thank you, Your Honor for staying so late and being so diligent. It's much appreciated.

JUDGE MCCULLOUGH:

Thank you. Thank you.

BY ATTORNEY HIRSCH:

Q. Doctor Barber, there's a lot of tables in your reports.

Right?

A. Yes.

09:22:41 Q. And this is a table. Sometimes
09:22:44 words have two meanings, and I feel
09:22:48 like we're using today in this
09:22:48 courtroom the word bias to mean two
09:22:51 wildly different things.
09:22:52 What is your definition of
09:22:54 bias? You use that word a lot in your
09:22:56 reports. Tell us what you mean.
09:22:59 A. I --- I think we need to know
09:23:01 the context because I think that
09:23:03 you're absolutely right. That bias
09:23:05 can mean different things in different
09:23:07 contexts. And so, I --- I think
09:23:09 you're exactly correct, but it's very
09:23:12 context dependant.
09:23:14 Q. When you're comparing maps to
09:23:15 your set of simulated maps and saying
09:23:17 that some are biased, in that context,
09:23:20 what do you mean?
09:23:21 A. So in that context what I mean
09:23:23 is that the plan that we're --- and
09:23:28 analyzing, the particular proposal is
09:23:31 not in line with the middle range of
09:23:36 --- of the simulations. It sits at
09:23:39 the edge. It's an outlier, and ---

09:23:40 and that's what I mean when I'm
09:23:42 talking about bias with regards to
09:23:44 comparisons to the set of simulations
09:23:50 that have been drawn.
09:23:50 Q. And you'd agree with me that at
09:23:51 times, that definition of bias can be
09:23:54 useful in routing out an intentional
09:23:57 partisan gerrymander?
09:23:59 A. Yes, it can certainly be
09:24:03 helpful. It's --- and that's in fact
09:24:05 why it's been used in a variety of
09:24:06 litigation cases.
09:24:07 Q. And --- and I'd imagine you'd
09:24:08 also agree with me that voters can be
09:24:10 harmed by an unintentional partisan
09:24:15 gerrymander.
09:24:15 Right?
09:24:16 A. I think that's true, yes.
09:24:17 Q. And would you also agree with
09:24:19 me that the way they're harmed is that
09:24:21 depending on their political
09:24:23 viewpoints or their partisan
09:24:24 affiliation, when they cast that
09:24:27 ballot, some people's vote is more
09:24:30 powerful than others. That's the

harm.

Right?

A. I --- I would only amend that statement slightly and say it's perhaps less efficient in how their vote is translated to representation.

Q. Fair enough. So perhaps 3,000,000 people vote Democratic and 3,000,000 vote Republican, and for some reason that doesn't result in an even split of seats. It results in an uneven split. That would be the harm to the voters whose 3,000,000 votes got them less than half the seats.

Right?

A. Yes, I think that's correct.

Q. So now --- now I want to ask you, I think about the old saw about, I can't remember the exact number. But if you put a million monkeys in front of typewriters, sooner or later someone's going to --- someone's going to bang out the Lord's prayer. Let's forget about intentional partisan gerrymandering and just think about

09:25:30 the harm to the voters.

09:25:30 And let's say those monkeys
09:25:30 banged out two redistricting plans.
09:25:35 And let's say they're identical for
09:25:37 all practical purposes on every metric
09:25:39 of traditional redistricting criteria.
09:25:40 But one of them looks a whole lot like
09:25:44 the median plan, the middle plan, the
09:25:48 average plan in your simulation. So
09:25:51 it's completely unbiased in that first
09:25:54 sense, but it's very biased in the
09:25:56 second sense in that it'll result in
09:26:00 one party's voters getting a lot fewer
09:26:03 seats out of their votes than the
09:26:05 other because they're not getting that
09:26:07 efficient translation you spoke of.
09:26:09 And the other monkey does the
09:26:11 opposite. They get rid of the bias
09:26:15 that harms the voter, so the voters
09:26:17 are treated equally but they've
09:26:19 created an outlier compared to your
09:26:21 simulated maps.

09:26:25 What is your instruction to the
09:26:28 Court about which of those two maps
09:26:30 should be chosen if those are the only

two options?

A. So I actually think I addressed this at the beginning of my report when I talk about what does it mean when we see a plan that's not in line with the simulations? And my intent is not to say that that immediately impugns the intentions or the dignity of the map drawer. It simply says, well we have this set. We --- we have this set of simulated plans, and we know the criteria with absolute certainty as to how they were drawn. We have this other plan that we don't know with absolute certainty the criteria that were used to draw the plan.

If that plan is not in agreement with the simulations, it strongly suggests that some other criteria were used to draw that plan. What that other criteria are requires additional analysis, but that's what I'm --- that's what I'm saying.

Q. But --- but I think you're

fighting with a hypothetical. I'm asking you if there's no difference in the intent of the line drawer and there's no difference in the respect for traditional districting principles. And the only difference is one map looks like a random, average map but really hurts half of the voters in the state. And the other treats all voters equally, but is not at all random. It's an outlier.

It's a simple question. What is your understanding of what the Judge should do in that situation? Because that may be exactly the situation the Judge is confronted with in this case. Do you have an opinion on that?

A. So you're saying holding all other factors equal, and you have the choice between these two plans, then I think you could pick the one that was less biased. But I think we're making ---.

09:28:23 Q. Less bias in the sense of being
09:28:25 fair and equal to all voters?
09:28:28 A. Sure.
09:28:31 Q. I think when you were applying
09:28:33 to Princeton University for graduate
09:28:35 school I imagine you took the GRE.
09:28:38 Right?
09:28:39 A. I did, yes.
09:28:40 Q. And I imagine you didn't sit
09:28:42 there between the test date and the
09:28:45 date when you got your results just
09:28:46 saying I wish I got a median score.
09:28:49 You wanted a good score.
09:28:49 Right?
09:28:52 A. Well.
09:28:52 Q. You got into Princeton?
09:28:53 A. I --- I took the GRE twice
09:28:57 partly for that reason.
09:28:58 Q. There you go. Let me ask you
09:29:05 about your index that you use to
09:29:05 measure partisanship of districts. If
09:29:10 I understand correctly, you're taking
09:29:10 all the votes cast in these 17
09:29:14 statewide elections and putting them
09:29:15 in a big pool, and then looking at the

09:29:16 Democratic fraction and the Republican
09:29:19 fraction.
09:29:20 Is that right?
09:29:23 A. Yes, that's correct.
09:29:23 Q. You're not taking each of the
09:29:23 17 elections, figuring out the
09:29:24 Democratic and Republican results and
09:29:24 then averaging them, because that
09:29:26 would weight each election equally,
09:29:30 but it wouldn't weigh each vote
09:29:35 differently?
09:29:36 A. That --- that's exactly the
09:29:37 difference.
09:29:37 Q. And you mentioned earlier that
09:29:40 we should be reluctant to think that
09:29:48 older elections will predict future
09:29:48 elections. You also mention that you
09:29:50 only use elections from the last
09:29:51 decade. So there's a principle there
09:29:53 that in terms of thinking about how
09:29:56 this map would perform in the future,
09:29:57 all things being equal newer elections
09:30:05 are more probative than older
09:30:05 elections.
09:30:05 Correct?

09:30:05 A. All things being equal that I
09:30:06 think is correct. But I think that
09:30:09 all things equal is often not the
09:30:12 case.
09:30:12 Q. And it --- sure, of course. Is
09:30:14 it correct that of your 17 elections,
09:30:18 five of them are from 2012?
09:30:21 A. Yes, I believe that's the case.
09:30:23 Q. And is it correct that the
09:30:25 redistricting plan the Court will
09:30:26 adopt will be in place for three
09:30:29 midterm elections, 2022, 2026 and
09:30:34 2030?
09:30:35 A. The midterm races would occur
09:30:40 in those years, yes. That's correct.
09:30:42 Q. And it'll be in effect for only
09:30:44 two Presidential Elections, 2024 and
09:30:46 2028?
09:30:48 A. I, yes. That is correct.
09:30:49 Q. And I assume you know that
09:30:50 turnout is dramatically higher in
09:30:55 Presidential Elections than in midterm
09:30:58 elections?
09:30:59 A. Yes, that's the case.
09:31:01 Q. And is it correct that you have

14 Presidential Election year results and three midterm elections in your mix?

A. That's correct. They're not --- sorry.

Q. And by count --- and by counting each of the elections, not each of the elections equally but each vote equally, you are actually weighting the Presidential Elections more heavily even than that 14 to 3 split would suggest because there are so many more votes cast in 2012, 2016 and 2020 than in 2014 and 2018 which were midterm elections.

Right?

A. There are more votes cast. There are other races that occur at the same time. And so, it's not the case that the Presidential Election is being overrepresented because at the same time ---.

Q. Not the --- not the Presidential Election. I said the presidential year.

09:31:47 ATTORNEY MORGAN:

09:31:47 Objection, Your Honor. I would appreciate counsel letting the witness finish his answer.

09:31:49 ATTORNEY HIRSCH:

09:31:53 Please, I apologize.

09:31:54 JUDGE MCCULLOUGH:

09:31:54

09:31:54 I think he was trying to finish the end of his sentence, if you could.

09:31:55 ATTORNEY HIRSCH:

09:31:58 I apologize.

09:31:58 THE WITNESS:

09:31:58 So because there are other races that occur in the Presidential Election years, those

09:32:01 races are contributing to the index as well. It's not the case that the, only the Presidential Election is used

09:32:05 in those years.

09:32:07 BY ATTORNEY HIRSCH:

09:32:10 Q. I may have misspoken, but I thought I said Presidential Election

09:32:10 year elections. So are you aware of

09:32:16 the fact that the row offices in
09:32:17 Presidential years have higher turn
09:32:20 out than the gubernatorial election in
09:32:28 midterm years?
09:32:28 A. Yes, I am aware of that.
09:32:29 Q. I want to ask you a little
09:32:31 about your 50,000 simulations. I'll
09:32:34 try not to be repetitive with the
09:32:36 prior counsel.
09:32:40 Did you consider doing a
09:32:41 simulation where you did not require
09:32:43 the districts to be contiguous?
09:32:46 A. No.
09:32:47 Q. Why not?
09:32:51 A. My initial response would be I
09:32:53 --- I don't even think that the model
09:32:56 would be capable of doing that.
09:32:58 Q. Well, sure. It could just draw
09:33:00 random BTDs from around the state and
09:33:05 combine them into 17 districts.
09:33:11 Why not?
09:33:12 A. You would have to write a
09:33:12 different algorithm to do that.
09:33:12 Q. It'd be easier. You wouldn't
09:33:12 even have to keep track of contiguity.

09:33:13 Would it result in the same
09:33:14 distribution of partisan outcomes if
09:33:16 you did it that way?
09:33:17 A. Of course not.
09:33:18 Q. What if you said we don't care
09:33:20 at all about population equality? We
09:33:23 could have 10,000,000 in one districts
09:33:25 and 100 in another, that's fine.
09:33:27 Would that result in a different
09:33:29 distribution of partisan outcomes?
09:33:31 A. That's exactly the reason why I
09:33:33 don't allow the model to do that.
09:33:35 Q. Exactly.
09:33:35 A. And I set that half of percent
09:33:40 criteria.
09:33:40 Q. Did you control in your
09:33:47 algorithm for the constitutional
09:33:50 requirement of keeping wards whole?
09:33:52 A. I did not have --- that is not
09:33:55 an input in the model.
09:33:55 Q. And I assume that too could
09:33:57 affect the distribution of partisan
09:33:58 outcomes?
09:33:58 A. It's certainly possible that it
09:34:00 could.

09:34:00 Q. Did you control for the number
09:34:02 of incumbent pairings that happen in
09:34:10 each plan in your simulated 50,000
09:34:10 maps?
09:34:11 A. I did not. Because as I said,
09:34:12 I was sticking to those initial
09:34:14 redistricting criteria.
09:34:17 Q. Well some of them, but you
09:34:17 already said you weren't sticking to
09:34:19 wards even though they're in the
09:34:20 constitution.
09:34:21 Correct?
09:34:21 A. With regard to wards, yes.
09:34:25 That's correct.
09:34:26 Q. As to incumbent pairings, after
09:34:28 the fact did you check just as you did
09:34:30 for partisanship? Did you check to
09:34:31 see how many pairings there were in
09:34:32 each plan?
09:34:33 A. No, I did not.
09:34:34 Q. So you can't say sitting here
09:34:36 today that a majority of those plans
09:34:38 don't have five, six, seven pairings?
09:34:41 You have no idea?
09:34:42 A. That's correct.

09:34:44 Q. And did you check after the
09:34:45 fact to see if every plan had two or
09:34:51 three majority/minority voting age
09:34:52 population districts as does every
09:34:54 plan submitted to this Court?
09:34:58 A. So I have the analysis that we
09:35:00 looked at that says let's consider the
09:35:04 districts that meet that criteria, and
09:35:07 then the second set of simulations
09:35:09 that enforce that criteria of having a
09:35:14 particular threshold of majority
09:35:17 opportunity districts.
09:35:18 Q. I --- I asked specifically
09:35:19 about majority/minority voting age
09:35:21 population districts. Whether there
09:35:23 were two or three of them in all of
09:35:25 your 50,000 maps. The answer to that
09:35:29 is you don't know or no?
09:35:34 A. On --- on the 50,000 maps?
09:35:36 Q. Yes.
09:35:37 A. It's, I don't know off the top
09:35:38 of my head.
09:35:43 Q. You reported the median for
09:35:46 your maps and you said the median
compactness figure for the mean

Polsby-Popper score was .28.
Correct?
A. The ---?
Q. In your simulated 50,000 maps.
09:35:59 A. In the --- I'm sorry, yes. In
09:36:00 the --- in the simulations, yes.
09:36:00 That's correct.
09:36:01 Q. And are you aware that every
09:36:03 single map submitted to this Court
09:36:04 does better than that?
09:36:08 A. Yes.
09:36:08 ATTORNEY HIRSCH:
09:36:10 No further questions.
09:36:11 JUDGE MCCULLOUGH:
09:36:11 Thank you, Counsel. Mr.
09:36:34 Wiygul, you can come over.
09:36:34 ATTORNEY WIYGUL:
09:36:35 Thank you, Your Honor.
09:36:35 ---
09:36:35 CROSS EXAMINATION
09:36:36 ---
09:36:36 BY ATTORNEY WIYGUL:
09:36:36 Q. Good evening, Doctor Barber.
09:36:36 A. Hello.
09:36:37 Q. I'm --- my name is Robert

09:36:37 Wiygul. I am counsel for the Governor
09:36:38 in this action. I want to ask you
09:36:39 first about your ensemble analysis
09:36:42 here. I believe you call it
09:36:44 simulations. First in your
09:36:46 professional opinion, are Markov Chain
09:36:53 techniques the leading methods for
09:36:53 generating map samples?
09:36:56 A. I would say --- I would say
09:36:56 that's the case. There's a number of
09:36:58 different algorithms that people use.
09:37:07 Many of them use the --- the MCMC
09:37:08 method.
09:37:08 Q. Did you use an MCMC method?
09:37:12 A. So the model is based on MCMC
09:37:15 algorithm.
09:37:15 Q. Okay.
09:37:16 What --- what actually did you use?
09:37:17 A. So I --- I explained that the
09:37:18 model is from --- the model is written
09:37:23 by a researcher at --- a political
09:37:25 scientist at Harvard University.
09:37:30 Q. And I mean, what's the main
09:37:32 idea behind this approach?
09:37:33 A. So the main idea is that the

model takes these --- the geography of the state and it calculates what's called an adjacency graph. And so, it looks at all the different precincts that are connected to one another. And then it divides the State into these various districts, and then you know, at that point you have the simulated plan.

Q. Is that not more accurately described as a sequential Monte Carlo analysis?

A. Yes, that's correct.

Q. That --- that's different than a Markov Chain Monte Carlo analysis. Correct?

A. Yes, that's correct.

Q. Okay. And Markov chain, just so we're clear, the Markov Chain Monte Carlo analysis is the leading method for generating map samples?

A. Again, I would say there's a variety of --- a variety of algorithms out there. Many of them use that